AFRPL-TR-72-77

### PROPELLANT IMPROVEMENT

### **PROGRAM**

Volume I, Part I - Compatibility Of Material With Standard HDA

Henry Ph. Heubusch, et al

P.O. Box 1
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### **FOREWORD**

This report covers the work accomplished by the Bell Aerospace Company (BAC) during the period March 1972 through June 1972 on Task 1 - Standard HDA Compatibility, of the Propellant Improvement Program for the Air Force Rocket Propulsion Laboratory, Liquid Rocket Division, Edwards Air Force Base (EAFB), California. The work was conducted under Contract FO4611-72-C-0026 under the direction of AFRPL Project Engineer, Lt. J. Bon.

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### **ABSTRACT**

Sets of static, corrosion tests were performed to evaluate candidate materials being considered for use with standard HDA (High Density Acid), since the latter was known to be relatively corrosive. The tests were performed at temperatures and times representative of anticipated service conditions for each material. Measurements and observations were made both for changes in the acid and the material. This included chemical analyses and corrosion rates calculated from changes in weight. Based on the results, the materials were ranked in one of four categories, ranging from satisfactory for general use to unsatisfactory. A number of aluminum alloys fell in the former category. Stainless steels appear good for limited use. Results for all materials are tabulated in the text. The general conclusion reached was that a better corrosion inhibitor is needed to extend the choice of materials for the design and test engineer. It was recommended that compounds containing fluorine and phosphorous be evaluated.

### CONTENTS

Section	l			Page
I	INTRO	DUCTIO	ON	1
II	SUMM.	ARY		2
	1.0	TEST	DESCRIPTION	2
	2.0	TEST	PROCEDURE AND ANALYSES	2
	3.0	TEST :	RESULTS	2
m	TECHN	NICAL 1	DETAILS	4
	1.0	SAMP	LE PREPARATION	4
	2.0	DESCR	RIPTION OF CORROSION TEST VESSEL	4
	3.0	CORRO	OSION TEST PROCEDURE	4
	4.0	CORR	OSION TEST RESULTS	5
		4.1 4.2	Acids For Corrosion Tests At 120°F	5 5
		4.3	Test Conditions And Acid Analyses - Summary At 120°F	6
		4.4	Test Data Computer Code	6
		4.5	BAC Sponsored Fruehauf Material Test Results Data .	6
		4.6	Short Term - High Temperature And Extended Storage	
			Low Temperature Test Results	6
		4.7	Nonroutine Analyses	6
īV	TECHN	NICAL I	DISCUSSION	8
v	CONCI	LUSION	S	9
VI	REFER	RENCES	5	10
			ILLUSTRATIONS	
Figure				Page
1	HDA C	orrosio	n Test Vessel	12

### TABLES

Number		Page
I	Ratings Of Materises For Service In Standard HDA	13
II	Compatibility Classification Of Material With Rocket	
	Propellants	16
III	Sample Preparation	17
IV	Acids For Corrosion Tests At 120°F	21
v	Acid Analyses For Corrosion Tests At 120°F	23
VI	Corrosion Test Results - 7 Days At 120°F	25
VΠ	BDA Corrosion Test Computer Code	28
VIII	Acids For BAC-Sponsored Corrosion Tests At 120°F	29
IX	and Analyses For BAC-Sponsored Corrosion Tests At 120°F	30
X	MAC-Sponsored Corrosion Test Results 7 Days At 120°F	31
XI	Reids For Corrosson Tests At 220°F	32
XII	Ac d Analyses For Corrosion Tests At 220°F	33
XIII	Corrosion Test Results - 6 Hours At 220°F	34
XIV	Acids For Corrosion Tests At 90°F	35
XV	Acid Analyses For Corrosion Tests At 90°F	37
XVI	Corrosion Test Results - 60 Days At 90°F	40
XVII	Nonroutine Analyses	45
XVIII	HDA Compatibility Tests	47
XIX	Compatibility Of Various Metals With Standard HDA	48
XX	Satisfactory Materials For General Use With Standard HDA	51
XXI	Materials Satisfactory For Repeated Short Term Use With	
	Standard HDA	52

### SECTION I

### INTRODUCTION

Bell Aerospace Company, under Contract FO4611-72-C-0026 from the Air Force Rocket Propulsion Laboratory, screened candidate rocket engine materials through a set of Standard HDA (High Density Acid) compatibility tests. These tests represented part of Task I of a Propellant Improvement Program, as described in Exhibit "A-1" to the contract. Results of these tests are included herein. Other parts of Task I, which deal with several aspects of modified HDA Storability, form the basis for a separate forthcoming report. Pre-release of this report was requested as an aid to design engineers for an advanced Agena project.

### SECTION II

### SUMMARY

### 1.0 TEST DESCRIPTION

Fifty-nine candidate rocket engine materials from Airesearch, Bell Aerospace, Fruehauf, Lockheed and TRW were screened through corrosion tests with Standard High Density Acid. This included 19 tests for a total of 7 days at 120°F; 5 tests for a total of 6 hours at 220°F; and 38 tests for a total of 60 days at 90°F, as required by contract. Also, a number of company-sponsored tests were performed at 90°F and at 120°F. In addition to representing time and temperature effects, the tests provided comparisons between parent metals, welds and couples. In most cases, data were obtained for exposure to liquid and vapor. With few exceptions, S/V (Surface of Metal/Volume of Acid) was 1.0 in. -1. 2 "Alue intermediate between conditions in large tanks and small lines.

### 2.0 TEST PROCEDURE AND ANALYSES

All tests were performed according to standardized procedures for sample preparation, pre and post acid analyses and pre and post specimen evaluation. In select cases, special analyses were made for sample identification and/or identification of films built up on specimens and/or corrosion products dissolved in acid during test. Principal methods of analyses were by electron microprobe and emission spectroscopy. The objects of these analyses were to provide explanation for current tests and a basis for tests with inhibitors other than HF (hydrofluoric acid), as used in Standard HDA. Also, in select cases, metallographic analyses were performed for further interpretation of test effects on materials.

### 3.0 TEST RESULTS

Test results are presented in Table I of the Appendix. This table shows materials grouped under principal types, such as aluminum alloys, 300 series stainless steels, etc. Each major group is arranged according to the composition of the alloy. The table is further divided to show specific test results for a given material as functions of temperature and time. The results are in terms of a rating scheme commonly applied for materials under consideration for use with rocket propellants. This scheme is depicted in Table II.

Table II considers separately nonmetals and metals. In both cases, the rating for a given material depends both on the degradation in the propellant and its effect on the propellant. Class I materials are satisfactory for general use in contact with the propellant tested. Other classes are restricted in useage.

Referring to Table I again, note that higher temperatures are generally more detrimental to rating than longer periods of exposure. Under the conditions of interest, aluminum alloys are notable for their compatibility with Standard HDA. A better corrosion inhibitor is clearly required to extend the design engineer's choice to other materials.

### SECTION III

### TECHNICAL DISCUSSION

### 1.0 SAMPLE PREPARATION

Regardless of source, sample preparation for testing was guided by two principles. The first was that only those mechanical operations required for sample identification and achievement of S/V=1.0 in. $^{-1}$  were to be performed. The second was that only those cleaning operations considered standard practice in nitric acid engine operations were to be performed. Numbering of samples for identification was waived if a danger existed of affecting the surface, as in the case of plated samples. Within limits dictated by sample size for reliable analyses, acid volume was adjusted to meet S/V before the test specimen was reduced in size.

The form in which each material was received for test, its source, and the subsequent mechanical and cleaning operations performed are given in Table III. For convenience, the materials are collected according to test temperature. All materials, including Bell Aerospace Company-sponsored materials are included therein.

### 2.0 DESCRIPTION OF CORROSION TEST VESSEL

Bell Aerospace has developed a simple, rugged vessel for conducting corrosion tests over a relatively wide range of S/V and temperatures. See Figure 1. The basic unit consists of a heavy wall aluminum cylinder to which is bolted an aluminum cap with handle. To provide an inert surrounding, a Teflon liner and cap are fitted into the vessel. A Teflon hanger is suspended from the cap. The hanger allows exposure of separate specimens to liquid and vapor when the vessel is partly filled with acid.

### 3.0 CORROSION TEST PROCEDURE

The same corrosion test procedure was used in all cases. Standard HDA was blended and analyzed in accordance with the standardized procedures contained in Reference 1. Then, a known volume was transferred into a Teflon-lined, aluminum, corrosion test vessel containing tared specimens, arranged for exposure one to the liquid and another to the vapor phase. The loaded vessels were held in an oven at constant temperature for the test duration. The acid and specimens were then removed for re-analysis, inspection and weighing. Particular attention was paid to the appearance of the acid, because of concern over suspended corrosion products. Visual and optical examinations were made of the specimens with metallographic analyses, where warranted. Corrosion rates were calculated from change in weight. Weight of deposits removable from the specimens were also noted. In select cases, a combination of emp (electron microprobe), chemical and spectrographic analyses were used to identify the corrosion products in the acid and the films present on the specimens.

### 4.0 CORROSION TEST RESULTS

The first contractual set of corrosion tests consisted of exposure of specified materials to Standard IDA for 7 days at 120°F. Test conditions supporting chemical analyses and test observations are contained in Tables IV through VI.

### 4.1 Acids For Corrosion Tests At 120°F

Table IV lists the test conditions. These include the test identification number, the material tested, its source, the type NTO (nitrogen tetroxide) and relative levels of H<sub>2</sub>O and HF (hydrofluoric acid) blended by weight with the nitric acid and nitrogen tetroxide, the test duration and temperature and source of ingredients used to prepare the HDA. WFNA-H (white fuming nitric acid-H; H is a code which indicates eighth batch number) was the eighth bottle of nitric acid used at Bell Aerospace Company for these tests. LM-F represents a grade of NTO containing approximately 1.0 wt% (weight-percent) NO, which imparts a green color and has been filtered to remove particulates. The NTO designation Gn Gn signifies that the final product contained all green NTO. As indicated, HF was added to the acid blends from a cylinder of commercially available material. No water was added to the blends.

### 4.2 Acid Analyses For Corrosion Tests At 120°F

Table V contains the results of pre and post analyses of the acids used for test. Chemical composition is expressed in terms of wt% of the principal ingredients: nitric acid (HNO3), nitrogen tetroxide in equilibrium with nitrogen dioxide (NO2), water, and hydrofluoric acid (HF). Corrosion products are expressed in terms of wt% of iron oxide (Fe $_2$ O3), metal oxides (M $_2$ O3) and total nitrate (TN). Little build up in Fe $_2$ O3 is expected in tests of aluminum. For such tests, it is customary to analyze only for M $_2$ O3 and to use the aluminum factor to express results as anhydrous, total nitrate. The appearance of the acid is an indication of quality from a use standpoint. Clear acid presents no problem. Particles are suspended corrosion products, generally in a saturated solution.

Experience has demonstrated a level at which particles will not jeopardize operations by plugging orifices, filters, etc. The top level allowed is designated OK. Higher levels are designated P and > P respectively.

The standardized methods of analyses used consisted of a redox titration for NTO, direct determination of water by NIR absorbance, and specific ion electrode analyses of a neutralized sample of acid for fluoride. Iron was determined colorimetrically, since suggested atomic absorption procedures gave low results. Total oxides were determined after ignition. Total nitrates and nitric acid values were by calculation.

### 4.3 Test Conditions and Acid Analyses - Summary At 120°F

Table VI contains a summary of test conditions and acid analyses. Of most importance is the qualitative and quantitative information about the material tested. The qualitative data are given in terms of the physical appearance of the samples after exposure to acid and its vapors. N.E. designates no effect discernible. Colors for deposits are abbreviated and a general description of the deposits and/or substrate is given.

Quantative data are given in forms of weights of deposits removeable from the test specimens and corrosion rates calculated from changes in weight. Rank is based on one portion of Table II.

### 4.4 Test Data Computer Code

The numbers in parenthesis in Table VI are codes used to computerize test results for statistical treatment. The definition of this code is shown in Table VII.

### 4.5 BAC-Sponsored Fruehauf Material Test Results Data

Data for 7 day, 120°F tests of materials under consideration by Fruehauf for construction of a tank truck for HDA service are presented in Tables VIII, IX and X. The computer code of Table VII is applicable to Table X.

### 4.6 Short Term - High Temperature and Extended Storage - Low Temperature Test Results

Results of short term, high temperature, tests can be seen in Tables XI, XII and XIII. Extended storage tests at 90°F are shown in Tables XIV, XV, XVI. The computer code of Table VII is applicable to Tables XIII and XVI.

### 4.7 Nonroutine Analyses

Nonroutine analyses are summarized in Table XVII. This table shows that particles lent to HDA by exposure to nonmetals were filtered off, weighed and, as required, identified by spectroscopic analyses, as requested by Airesearch. The films on a cross-section of the metals exposed to HDA were isolated and analyzed by emp, to determine what alloying elements were being attached and what type of protective film, fluoride, oxide, etc. was being formed. Emission spectroscopy and spot tests were used to expand these data. Supplemental spectroscopic data were obtained for residues left after evaporation of solids from corrosion tests. Other analyses, such as gravimetric determination of nickel in the NVR from a test Au/Ni Braze Alloy and carbon analyses and spectroscopy for sample identification, were also performed.

In addition, there were a number of samples where microscopic observation indicated peculiar attack. These were submitted for metallographic analyses. Results are summarized in Table XVII and given in detail in References 2 and 3.

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### SECTION IV

### TECHNICAL DISCUSSION

Close inspection of the tabulated data reveals only a few instances where S/V could not be adjusted to 1.0 in. $^{-1}$ . A value of 0.1 in. $^{-1}$  had to be used for a small disc of platinum - cobalt alloy. The total surface of couples was such as to make S/V = 1.0 in. $^{-1}$ . Therefore each component was at a smaller value. The proportions can be determined, if desired, from the data in Table III. These data were representative of proportions normally used. Since the couples were easily disassembled, it was possible to calculate the separate corrosion rates for each component. Thus, the double entries in the tables. Although S/V = 1.0 in. $^{-1}$  is reported for all welded samples, those involving bellows segments and parallel sheets welded together represent special cases that are susceptible to crevice corrosion.

It has already been mentioned (in a general way) that where comparisons were possible it appeared higher temperature was more detrimental to a specimen's resistance to HDA than a longer period of exposure at a lower temperature. This, of course, is as it should be, but is reassuring since it indicates that test times, which were reduced with increasing test temperature, were long enough to provide reliable data. On the other hand, one would be penalizing a material to test it at a temperature higher than service conditions. For tests at 90°F, it appears advisable to keep exposure time to at least 30 days. This conclusion is extrapolated from the present tests plus those reported in Reference 4. Review of the latter data applicable to 347 stainless steel is of interest.

A rating of Class II was assigned to 347 stainless steel largely because of an objectionable amount of particulate in the acid after 30 days at 90°F. These tests were conducted with the corrosion test vessels being held in a water bath with their tops in air. This condition permitted some reflux action. When the material was retested for 60 days, the test vessels were stored at uniform temperature in an oven. This change was sufficient to move the material from the Class II into Class I range, thus reinforcing the previous remarks about the importance of matching test and service conditions as closely as possible.

One test involving a couple of 304L stainless steel and Haynes - 25 alloy was rerun because of concern over the relatively high corrosion rate of the Haynes - 25. The repeat test was made with Haynes - 25 which had no past history of acid service. Corrosion rate fell to a reasonable level drawing attention to another important facet of corrosion.

One substitution of material for test was made. A 347 stainless steel/chrome plated Worthite couple was tested rather than a 302/Worthite couple when it was discovered that only the former was on the acid side of a valve assembly.

A sample received as 304 stainless steel showed unexpected resistance to HDA. Permission was received from the source to verify composition by analysis. A carbon determination coupled with a spectrographic analyses proved the material to be 304L.

A question of identity for another sample was solved by analyses which showed the material to be AM350.

Other nonroutine analyses brought out an interesting point. The identity of the films formed upon exposure to HDA was considered a choice between oxides and/or fluorides. Analyses of eight different type samples by emp showed only fluorides to be present. This finding will be compared with results for similar analyses being performed in support of tests with alternate inhibitors for HDA.

A final comment relates to earlier tests with Standard HDA (References 1 and 4). It appeared useful to combine results from these tests with data obtained under comparable conditions during the present study. Accordingly, Tables XVIII and XIX, covering nonmetallic and metallics respectively, were derived. One thus has immediate reference to the bulk of Standard HDA corrosion test data available to date.

### SECTION V

### CONCLUSIONS

Fifty-nine candidate materials for rocket engines were screened for HDA service. Those found generally satisfactory are grouped in Table XX. Those found acceptable for repeated, short term exposure are grouped in Table XXI. The ratings for all the materials tested are in the text.

Examination of Table XX shows several aluminum alloys with a Class I rating. Most of the data are from tests of seven days duration at 120°F. The one alloy in this group also tested at 90°F bore out the expectation that the rating would not fall at a lower temperature. Only three stainless steel samples exhibited a Class I rating, and this at 90°F. A poorer rating was obtained in both cases where one of the original group was tested at higher temperature. The actual values are shown in the table, set off by parentheses. A similar pattern is observed for other metals and nonmetals.

Examination of Table XXI shows several of the 300 stainless steels and the balance of the aluminum alloys. The values in parentheses are actual values. In addition, several other metals and nonmetals are available to design engineers. Rulon LD was not included in the Table because anomalous results were obtained as a function of temperature. Further testing would be required to obtain technical endorsement for this material.

The general conclusion from all the tests was that an improved corrosion inhibitor is needed to extend the range of materials for use in HDA. The search for such an inhibitor is in progress.

### **SECTION VI**

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- 3. "Metallurgical Examination Of Samples Exposed To HDA For 60 Days At 90°F, H. G. Kammerer, Bell Aerospace Co. Memo dated 23 June 1972.
- 4. "Technical Proposal For Propellant Improvement Program", Bell Aerospace Co. Report No. D8643-953002, 7 January 1972

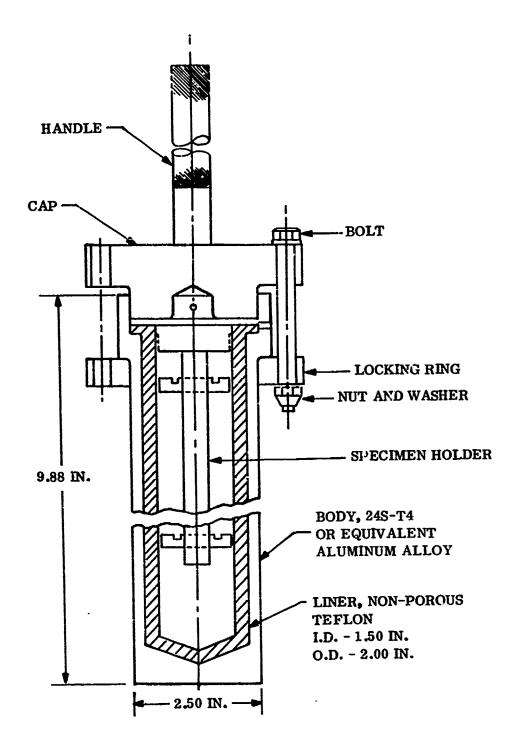


Figure 1. HDA Corrosion Test Vessel

 $\begin{tabular}{ll} TABLE\ I \\ RATINGS\ OF\ MATERIALS\ FOR\ SERVICE\ IN\ STANDARD\ HDA\ \ (1\ of\ 3) \\ \end{tabular}$ 

		Ratings 1	7
Material	6 Hours At 220°F	7 Days At 120° F	60 Days At 90°F
Aluminum Alloys			
356A Cast	<b></b> _		I
356-T6	II		I
A356-T6 Hard Anodized	īv		
356-T6/304 Couple		II/II	
356-T6/304L Couple		II/II	
2021/2021 Weld			II
2219/2219 Weld			п
5086		1 <u>2</u>	
5086 Welded		I 🖄	
5454-0		1 🖄	
5454-Н32		1 <u>2</u>	
5454-H32 Welded		1 <u>2</u>	
6061-T6		I 🖄	I
6061-TS Welded		1 <u>2</u>	
6061-T6/304L Ccuple	II/1	II/1	
Nituff On 6061 A1		n	
300 Series Stainless Steels			
302/304L Weld		II	
304/304-308 Filler Weld			11
304L/304L TIG Weld			11
304L	11		1/1
304L Work Hardened			II .
304L/Haynes-25 Couple	~~-	п/п-ііі	40 to, c.,
316		11	
			<b>_</b>



Refer to Table Ii For Rating Scheme

Bell Aerospace-Sponsored Test

**TABLE I** (2 of 3)

		Ratings 1	
Material	6 Hours At 220°F	7 Days At 120°F	60 Days At 90°F
300 Series Stainless Steels (cont)			
316 Spring Wire			I
321			п
321/321 - Bellows Res. Weld			II
321/321-347 Filler Weld			II
347		ш 🛕	I
347/347 TIG Weld		ш 🖄	II
347/AM350 TIG Weld		Ш	
347/Chrome Plated Worthite Couple		II/I	
Other Metals			
M-50 Alloy			II
440C		Ш	п
440C - Chrome Plated		IV	
440C - Rhodium Plated			Ш
440C - Chromized			īv
AM350 Bellows	Ш		
AM350 Screen			п
17-4 PH H1025			I
17-7 PH RH 950		П	
17-7 PH RH 1050		II	и
17-7 PH Fully Annealed - Cond, A	~~~		I
17-7 PH Spring Wire			I
17-7 PH Torque Tube		и 🖄	1 🛕
ARMCO 21-6-9		ш	II
20-Cb-3 (Carpenter 20 Cb)		II 🔼	П
		· · · · · · · · · · · · · · · · · · ·	



Refer to Table II For Rating Scheme Bell Aerospace-Sponsored Test

**TABLE I (3 of 3)** 

	R	atings 1	
Material	6 Hours At 220°F	7 Days At 120°F	60 Days At 90°F
Other Metals (cont)			
Haynes - 25 Screen	~	II	
Haynes - 25 Rhodium Plated			III
Haynes ~ 25 Chromized			III
Latrobe MP-35-N		ш 🛕	п
Pt - Co Alloy		I	
Au/Ni Braze Alloy			ш
Columbium C-130 (WR512E Coat)			ш
Nonmetals			
KEL-F 81		п	п
KEL-F 5500			ш
Rulon A			u
Rulon LD		II	ш
Rulon 123		п	1
25% Glass Filled Teflon			п
			-
•			

Refer to Table II For Rating Scheme

Bell Aerospace-Sponsored Test

TABLE II

COMPATIBILITY CLASSIFICATION OF MATERIAL

WITH ROCKET PROPELLANTS

	Compatibility	Classification of	Nonmetals	
Class	I	II	Ш	IV
Volume Change In Percent	0 To +25	-10 To +25	-10 To +25	<-10 Or>+25
Durometer Reading	±3	±10	±10	<-10 Or> +10
Effect On Propellant	None	Slight Change	Moderate Change	Severe
Visual Examination	No Change	Slight Change	Moderate Change	Severely Blistered, Cracked, Or Dissolved
General Usage	Satisfactory For General Use	Satisfactory For Repeated Short-Term Use	Satisfactory For Short- Term Use	Unsatisfactory
	Compatibi	lity Classification	of Metals	
Class	I	II	III	IV
Rating	Excellent	Good	Fair	Poor
Corrosion Rate In Mils/Year	< 1	< 5	5 To 50	> 50
Decomposition Of Propellant	No	No	Some	Extensive
Shock Sensitivity	No	No	No	Yes

NOTE: The classification of a material is based on the lowest rating of any of the properties

TABLE III

# SAMPLE PREPARATION (1 of 4)

Togs.	Staterial	Source	Temp	Form in Which Sample Was Received	Mechanical Operation(s)	Gleaning
5	21.0 8.0	Airesearch	320	Sheet Stock, 3/64-ir. thick	Sheared, drilled, deburred, numbered	Procedure A A
3 5	750	Airesearch	120	Bar Stock, 1 1/4-in. diameter	Cut in two with emery wheel, numbered	Procedure A
9 0	72-7 111 818950	Airesearch.	120	Sheet Stock, 1/32-in. thick	Sheared, drilled, deburred, numbered	Procedure A
200	17-7 838 8113 050	Alresearch	120	Sheet Stock, 1/32-in. thick	Sheared, drilled, deburred, numbered	Procedure A
	17-7 tot Torone Tube	Bell Aerospace	120	Machined Part, 1/8 in. capillary	None	Procedure A
; ;	# X - 1 - 2 X	Alresenrch	120	llod, 1-in, dinmeter		Procedury 7
	Tulon LD	Atresonrch	120	Rod, 1-in, dinmeter		
190	Rulon 123	Airesearch	120	nod, '-in. diameter	Machined 1/8-in, wafers on lathe, numbered	Procedure C (1)
185	Cr plated 440C	Airesorrch	130	plated (0.4 mil) filing (except ID), 3/4-in. OD, 3/4-in. ID, 1/4-in. thick	None	Acetone degrease, oven dry at 190°: for 30 min.
159	Pt-Co Alloy	Airesourch	120	Disc, Rough Faces, 3/8-in. diameter	None	Acetone degrease, oven dry at 190°F for 30 min.
191	NITUPF on 6061 A1	Airesenret	120	Pinte, 1/4-in, thick, NITUFF on all but 2 ends	None	Acetone degrease, oven dry at 190°F for 30 min.
7	Armeo 21 -6-9	Aireacarch	120	INSC, 1/4-in, thick	Sawed, drilled, deburred, numbered	Procedure A (1)
198	Haynes-25 Sereen	Rell Acrospace	120	Cone in cylinder, 1/2-in. diameter, 1/2-in. long, 6 mil wire	None	Procedure A 213
185	347/AM 350 Tig Wold	Airesearch	120	Section of bellows	Deburred, numbered	Acetone degrease, oven dry at 190°F for 30 min.
40 64 64	302/3041, Weld	Bell Aerospace	120	part of 304L Impelier/302 Pin, 1/8-in. diameter	Sawed, deburred, numbered	Procedure A 1
730	356-T6/304 Couple	Bell Acrospace	120	Machined Plate, 5/34-in. thick/part of Bearing Race, 1/16-in. thick	Drilled, deburred, numbered/Sawed drilled, deburred, numbered/Coupled with Teffon nut and bolt	Procedure B/Procedure A
231	356-T#/304L Couple	Bell Avrospace	120	Casting, 1/4-in. thick/bar stock, 1-in. diameter	Sawed, drilled, deburred, numbered/ Machined on lathe, drilled, deburred, numbered/Teflon nut and bolt	Procedure B/Procedure A
232	6061-T6/3041. Couple	Bell Aerospace	021	Shert Stock, 1/16-in. thick/Bar Stock, 1-in. diametur	Sheared, drilled, deburred, numbered, anodized (2) /Machined on lathe, drilled, deburred, numbered/Tellon nut and bolt	Oven dried at 190°F for 30 mtn./Procedure A A 3
226	304L/Haynes-25 Couple	Bell Astroaptee	120	nar Stock, 1-in. diameter/Cylinder as above	Machined on lathe, drilled, deburred, numbered/None/Teffon nut and bolt	Procedure A/Procedure A.
# 77	347/Cr plated Worthite Couple	Bell Agrospace	120	sheet Stock, 1/10-in, thick/Bar Stock 1-in, diameter	Sheared, at itled, deburred, numbered, /Machined on lathe, drilled, deburred, numbered, plated (4 mil)/Teffon nut and bolt	Procedure .1/Acetone de- grease, oven dried at 190° F for 30 min.
221	356-70	Bell Aerospace	220	Milled Plate, 1/32-in. thick	Machined on lathe, drilled, deburred, numbered	Procedure 11 🚺
	**************************************					

466

Sen Sheet 4 Suffuric acid anodize with sodium dichromate seal Ulcaned at component level

## TABLE III (2 of 4)

 Material	Source	Test Temp	Form in Which Sample Was Received	Mechanical Operation(s)	Cleaning	
 A356-T6 Hard Anodized	Bell Aerospace	320	plate, 1/2-in. thick, Anodized	Sawed, drilled, deburred, numbered	Acetone degrease, oven dried at 190°F for 30 min.	
 304L	Bell Acrospace	220	Bar Stock, 1-in. diameter	Machined on lathe, drilled, deburred, numbered	Procedure A 1	
 AM350	Dell Aerospace	320	Section of bellows	Sawed, deburred, drilled, numbered	Acetone degrense, oven dried at 190°F for 30 min.	
 6061-T8/304L Couple	Bell Aerospace	330	Sheet stock, 1/16-in. thick/Bar Stock, 1-in. diameter	Sheared, dellied, deburred, numbered, anodized (2) /Machined on lathe, di illed, deburred, numbered/Teflon nut and soft	Actione degresse, oven dried at 190°F for 30 min.	
 356A Cast	LMSC	90	Machined and Ground Plate,1/8-in, thick	Drilled, deburred, numbered	Procedure B	
 1061-16	Bell Aerospace	90	Sheet Stock, 1/10-in. thick	Sheared, drilled, deburred, numbered	Procedure B	
 356-76	Bell Aerospace	90	Casting, 1/4-in, thick	Sawed, drilled, deburred, numbered	Procedure B	
 304(1)	LMSC	96	Milled Plate, 1/4-in, thick	Sawed, drilled, deburred, numbered	Procedure A	
3041.	Bell Aerospace	90	Bar Stock, 1-in. diameter	Machined on lathe, drilled, deburred, numbered	Proceedure A	
3041, Work Hardened	TRW	8	Shim Stock, 4 mil thick	Sheared, numbered	Procedure A	
316 Spring Wire	Airesearch	90	Wire, 3/64-in, diameter	Sheared	Pricedure A	
 -76	LMSC	90	Sawed Plate, 3/8-in. thick	sawed, drilled, deburred, numbered	Procedure A	
 347	Nell Aerospace	06	Sheet Stock, 1/16-in. thick	Sheared, drilled, deburred, numbered	Procedure A	
AM350 Sereen	LMSC	96	Screen, 10 mil	Sheared	Procedure A	
17-4 PH II 1025	LMSC	96	Sawed Pinie, 5/32-in, thick	Drilled, debarred, numbered	Procedure A	
17-7 PH PH 1050	LMSC	06	Machined part, 1/4-in. thick	Sawed, deburred, numbered	Procedure A	
17-7 PH Pull Annualed	TRW	06	sheet Stock, 1/64-in. thick	Sheared, deburred, numbered	Procedure A	
-110C	Airesearch	8	liar Stock, t 1/4-in. diameter	Machined on lathe, drilled, deburred, numbered	Procedure A	
Armco 21.6-9	Airesearch	8	Disc, 1/4-in. diameter	Sawed, drilled, deburred, numbered	Procedure A	
20-03-3	Airescarch	90	Bar Stock, 3/4-in. dlametor	Sawed, drilled, deburred, numbered	Procedure A	
(Carpenter 20 CB) 17-7 PH Spring Wire	Airescarch	8	Wire, 1/64-in, diar-eter	Shenred	Procedure A	
17-7 PII Torque Tube	Bell Aerospace	8	Machined Part, 1/8-in. capillary	None	Precedure A	
Kel-F 5500	Bell Aerospace	06	()-Hing, 3-in, diameter, 1/8-in, thick	None		
Kel-F 41	Airescarch	ន	110d, 1-in. dinmeter	Machined 1/8-in, thick wafers on lathe, drilled, deburred	Procedure C 11	

See Sheet 4 Sulfuric acid anodiza

Sulfuric acid anodize with sodium dichromata seal

## TABLE III (3 of 4)

250         Rudion A.         Airceasarch         90         Rod, 2/5-in, diameter         Machined 15-s-in. Buble waters of labely debarred debarred           250         Rudon LD         Airceasarch         90         Rod, 1-in, diameter         Nachined 15-in. Buble waters of labely debarred debarred           251         Chromized Haynes-25         Airceasarch         90         Hackined Part         Named debarred debarred debarred debarred debarred debarred with Tellon caps           252         Chromized Haynes-75         Airceasarch         90         Hackined Part         Named debarred deliber caps           253         Chromized Hayc         Airceasarch         90         Har, 1/4-in, diameter         None           254         Chromized Hayc         Airceasarch         90         Har, 1/4-in, diameter         None           254         Chromized Hayc         Airceasarch         90         Machined Haze, 1/3-in, blick         Soarch, deliber, debarred, minhered           255         Lat'cob Alloy         Airceasarch         90         Machined Haze, 1/3-in, blick         Soarch, deliber, debarred, numbered           255         Lat'cob Alloy         Airceasarch         90         Sheet, 1 1/2-in, diameter         Named debarred, deliber, debarred, numbered           250         Lat'Chail Lat, Webd         Airceasarch <t< th=""><th>Test No.</th><th>Material</th><th>Source</th><th>Test Temp</th><th>Form in Which Sample Was Heceived</th><th>Mechanical Operation(s)</th><th>Cleaning</th></t<>	Test No.	Material	Source	Test Temp	Form in Which Sample Was Heceived	Mechanical Operation(s)	Cleaning
Hulon LD         Aireaenech         90         Hod, 1-fn, diameter           Chromized Haynes-25         Aireaenech         90         Hod, 1-fn, diameter           Chromized Haynes-25         Aireaenech         90         Machined Fart           Ilh plated Haynes-25         Aireaenech         90         Mar, 1/4-in, diameter           Chromized 440C         Aireaenech         90         Machined Fart           Ilh plated 440C         Aireaenech         90         Machined Fart           Latrobe MP-35-N         Aireaenech         90         Machined Race, 1/9-in, thick           Latrobe MP-35-N         Aireaenech         90         Machined Race, 1/9-in, thick           Latrobe MP-35-N         Aireaenech         90         Sheet Stock, 1-in, diameter           Aux is Latrobe MP-35-N         THW         90         Sheet Stock, 1-in, diameter           Aux is Latrobe MP-35-N         THW         90         Sheet Stock, 1-in, thick           Aux is Latrobe MP-35-N         10         Sheet Stock, 1-in, thick           Aux is Latrobe MP-35-N         10         Sheet Stock, 1-in, thick           Aux is Latrobe MP-35-N         10         Sheet Stock, 1-in, thick           Aux is Latrobe MP-35-N         10         Sheet Stock, 1-in, thick           Aux	ş	Rulon A	Аігеяенгей	06	Rod, 3/8-in. dinmeter	Machined 1/8-in, thick wafers on lathe, deburred	Procedure C
Rudon 123   Attenuarch   90   Viachined Part	<b>9</b>	Aulen L.O	Airesearch	9	Hod, 1-in, dameter	Machined 1/8-in, thick wafers on lathe, drilled, deburred	Procedure C
Chromized Haynes-25         Alresearch         90         Mar, 174-in. diameter           Chromized 440C         Airesearch         90         flar, 174-in. diameter           Ilh plated 440C         Airesearch         90         flar, 174-in. diameter           M-50 Alloy         Airesearch         90         flar, 174-in. diameter           M-50 Alloy         Airesearch         90         Machined Race, 179-in. thick           Latobe MD-35-X         Airesearch         90         flar, 180ck, 1-in. diameter           Au/30 Hrate Alloy         LASC         90         Machined Race, 179-in. thick           Latobe MD-35-X         Airesearch         90         Sheet, 1-in. diameter           Au/30 Hrate Alloy         LASC         90         Machined Race, 179-in. thick           Latobe MD-35-X         Airesearch         90         Sheet Stock, 1 L/2-in. long, 5/4-in. thick           Latobe Latobe         LASC         90         Sheet Stock, 1 L/2-in. long, 5/4-in. thick           Machined Indiows         LASC         90         Sheet Stock, 1 L/2-in. long, 5/4-in. thick           Matrosented         1.00         Sheet Stock, 1 L/2-in. long, 5/4-in. thick         1.1/35C           Matrosented         1.00         Sheet Stock, 1 L/2-in. long, 5/4-in. thick           Machine	206	Rulon 123	Airesearch	86	flod, 1-in. diameter	Machined 1/8-in, thick wafers on lathes, drilled, deburred	Preciedure C
	<del>;</del>	Chromized Haynes-25	Airesearch	â	Stachtined Part	Sawed, drilled, debarred, ends protected with Teflon enps	Acetone degrease, oven dry at 190°F for 30 min.
Chromized 440¢         Aireaearch         90         Int. 1/4·in. diameter           31-50 Alby         Aireaearch         90         Wachined Race, 1/9·in. thick           Latrobe MP-35-X         Aireaearch         90         Machined Race, 1/9·in. thick           Latrobe MP-35-X         Aireaearch         90         Bar Stock, 1-in. diameter           Au/N: Braze Alloy         LMSC         90         Bar Stock, 1-in. diameter           Au/N: Braze Alloy         LMSC         90         Sheet, 1/9·in. thick           237 Glass Filled Teflon         LMSC         90         Sheet, 1/9·in. thick           201/2011 Tig Weld         Aireaearch         90         Sheet Stock 4 , 5/64-in. thick           221/211-347 Tig Weld         Aireaearch         90         Sheet Stock 4 , 3/64-in. thick           221/2212 Weld         LMSC         90         Sheet Stock 3/16-in. thick           221/2212 Weld         LMSC         90         Sheet Stock, 3/16-in. thick           221/2212 Weld         LMSC         90         Sheet Stock, 3/16-in. thick           221/2212 Weld         LMSC         90         Sheet Stock, 3/16-in. thick	953	1th plated Itayacs-25	Airesearch	8	Disc, t-in, diameter	None	Acctone degresse, oven dry at 190°F for 30 min.
11   12   1-10   11   12   1-10   11   12   1-10   11   12   1-10   11   12   1-10   11   12   1-10   11   12   1-10   11   12   12   1-10   11   12   12   1-10   11   12   12   12   12   12   12	243	Chromized 440C	Airesearch	90	Bar, 1/4-in, diameter	Sawed, drilled, deburred, ends protected with Teffon caps	Acctone degrenae, oven dry at 190°F for 30 min.
Ni-50 Alloy         Airesearch         90         Markined Race, 1/9-in, thick           Latrobe MP-35-N         Airesearch         90         Bar Stock, 1-in, diameter           Au/Ni Braze Alloy         LMSC         90         Sheat, 1/9-in, thick           237 Ghas Fulled Teffon         LMSC         90         Sheat Stock, 1 L/2-in, long, 5/64-in, thick           Columbium C-103         THW         90         Sheat Stock, 1 L/2-in, long, 5/64-in, thick           Columbium C-104         LMSC         90         Sheat Stock, 1 L/2-in, long, 5/64-in, thick           304/304-304 Fuller Weld         Airesearch         90         Sheat Stock 4 , 5/64-in, thick           311/301-347 Fuller Weld         LMSC         90         Sheat Stock 4 , 5/64-in, thick           321/321-347 Fuller Weld         LMSC         90         Sheat Stock 4 , 5/64-in, thick           324/304 Weld         Airesearch         90         Sheat Stock 3/16-in, thick           2241/321 Weld         LMSC         90         Sheat Stock, 3/16-in, thick           22519/2219 Weld         LMSC         90         Sheet Stock, 3/16-in, thick	ş	Ith plated 440C	Mresearch	96	Disc, 1-in, diameter	None	Acetone degresse, oven dry at 190°F for 30 min.
Latebe MP-35-N       Airestrarch       90       Har Stock, 1-in. diameter         Au/Ni Hraze Alloy       LMSC       90       Shert, 1/5-in. thick         25° Glass Filled Teflon       LMSC       90       Sheet, 1/5-in. thick         Columbium C-103       THW       90       Sheet Stock, 1 1/2-in. long, 5/64-in. thick         Columbium C-103       THW       90       Sweet Stock 1 1/2-in. long, 5/64-in. thick         Antescarch       90       Sweet Stock 4 , 5/64-in. thick         All /221-347 Tiller Weld       LMSC       90       Sweet Stock 4 , 5/64-in. thick         All /221-347 Till Weld       LMSC       90       Sheet Stock 4 , 5/64-in. thick         2021/2021 Weld       LMSC       90       Sheet Stock 4 , 5/64-in. thick         2130/212 Weld       LMSC       90       Sheet Stock 3/16-in. thick         2130/212 Weld       LMSC       90       Sheet Stock 3/16-in. thick	7	M-50 Alloy	Airesearch	90	Nachined Race, 1/8-in. thick	Sawed, deburred, numbered	Acutone degrense, oven dry at 190°F for 30 min.
1.835	200	Latrobe MP-35-N	Airesearch	96	Bar Stock, 1-in. diameter	Machined, drilled, debarred, rumbered	Procedure A 1
23° Gisas Fulled Teflon  LMSC  Columbium C-103  (W. I. 1831-E. Coan  204/304-304 Fuller Weld  Airescarch  204/304-304 Fuller Weld  Airescarch  204/304-304 Fuller Weld  Airescarch  2004/304-304 Fuller Weld  Airescarch  2004/304-304 Fuller Weld  Airescarch  2004/304-104 Fuller Weld  Airescarch  2004/304 Weld  LMSC  2004/304 Fuller Weld  Airescarch  Sheet Stock A 3/16 full thick  Airescarch  2004/304 Fuller Weld  Airescarch  Sheet Stock A 3/16 fuller thick  Airescarch  2004/304 Fuller Weld  Airescarch  Airescarch  Sheet Stock A 3/16 full thick  Airescarch  Airescarch  2004/304 Fuller Weld  Airescarch  Airescarch  Sheet Stock A 3/16 full thick  Airescarch	201	Au/St Braze Alloy	1.MSC	ŝ	Slip Ring, 9/16-in. 11)	None	Acctone degresse, oven dry at 190°F for 30 min.
Columbium C-103  (W. H. 1831.2E. Coan  (W. H. 1831.2E. Coan  204/304-304 ['iller Weld  Airesearch  204/304-304 ['iller Weld  Airesearch  204/304-304 ['iller Weld  Airesearch  2004/304-304 ['iller Weld  Airesearch  2004/304-104 [iller Weld  Airesearch  Airesearch  Airesearch  2004/304-104 [iller Weld  Airesearch  Airesear	9,7	15% Glass Filled Teffon	LMSC	ŝ	Sheet, 1/8-in. thick	Sheared, drilled, numbered	Procedure C
304/304-309 [viller Weld       LMSC       90       Sawed Plate, 5/16-in, thick         3011/2011, Trg Weld       Airesearch       90       Sheet Stock 4 , 5/64-in, thick         321 '321 -347 [viller Weld       LMSC       90       Sawed Plate, 5/18-in, thick         347/347 Trg Weld       Airesearch       90       Sheet Stock A , 3/64-in, thick         2021/2021 Weld       LMSC       90       Sheet Stock, 3/16-in, thick         2102/2219 Weld       LMSC       90       Sheet Stock, 3/16-in, thick	202	Columbium C-103	TRW	ŝ	sheet Stock, 1 1/2-in. long, 5/64-in.thick; Cont on both faces	None	Acetone degrense, even dry at 190°F for 30 min.
321'21'-347   1'g Weld	213	204/201-204 Piller Weld	LMSC	8	Sawed Plate, 5/16-in, thick	Sawed, deilled, deburred, numbered	Procedure A
321 (321 -347 (4)ther Weld   L.MSC   90   Sawed Plate, 5/18-in, thick   121 /321 Weld (16thows   L.MSC   90   Section of bellows   347/347 Tig Weld   Afresurch   90   Sawed Plate, 5/16-in, thick   2021/2021 Weld   L.MSC   90   Sheet Stock, 3/16-in, thick   1.MSC   90   Sheet Stock	253	nott, 'nott, Tig Weld	Alresearch	8	Sheet Stock 4 , 5/64-in, thick	Sawed, drilled, deburred, numbered	Procedure A
121 / 121 welded Betlows   LMK;   90   Section of Dellows   147/247 Tig Weld   Afresenreh   90   Sheet Stock   A   3/64-in, thick   2021/2021 Weld   LMK;   90   Sheet Stock   3/16-in, thick   2219/2219 Weld   LMK;   90   Sheet Stock   3/16-in, thick	214	221 /221 -247   Tiller Weld	LMSC	96	Sawed Plate, 5/16-in, thick	Sawed, drilled, debarred, numbers	Procedure A
347/347 Tig Weld Afresensch 90 Sheet Stock A 3, 3/64-in, thick 2021/2021 Weld LMSC 90 Sawed Plate, 5/16-in, thick 2239/2219 Weld LMSC 90 Sheet Stock, 3/16-in, thick	212	321/321 Welded Bellows	1,3180	õ	Section of bellows	Sawed, drilled, debured, numbered	Acetone degrense, oven dry at 136' F for 30 min.
2021/2021 Weld LMSC 90 Sawed Plate, 5/16-in, thick 223.9/2219 Weld LMSC 90 Sheet Stock, 3/16-in, thick	# # #	347/347 Tlg Weld	Airesearch	96	Sheet Stock A , 3/64-in, thick	Sawed, drilled, deburred, numbered	Priceative A A
2289/2219 Weld LMSC 90 Shret Stock, 3/16-in, thick	7.	2021/2021 Weld	LMSC	06	Sawed Plate, 5/164n, thick	Drilled, deburred, numbered	Procedure n
	345	225/2219 Weld	LMSC	£	sheet Stock, 3/16-in. thick	Sawed, drilled, deburred, numbered	Procedure B

54: Sheet 4 Parallet Sheeta welded together 

### TABLE III (4 of 4)

The contract of the contract o

Test No.	Vistorial	1	Source	Tost Temp	Form in Which Sample Was Received	Mechanical Operation(s)	(Heaning
			d¥.	ECIMEN CI	APECIMEN CLEANING PROCEIMIREA + STAINLESS STEEL SPECIMENS	SPECIMENS	
	ند	Acetone degrense	5 11				
	**	Detergent was	t Vol's Liquinos	nt 70°F) wil	Letvegene wash (1 Vol'6 Liquinon at 70°F) with abrasion (Scotchbriter) if senie noted		
	ei	Tap Water rieso	9				
	÷	Passivation in	passivation in 30-40 vol Entric acid at 140°F for 30 minutes	ncid at 140	F for 30 minutes		
·	ę,	Distilled water ringo	ringo				
	9	Oven dry at 190°F for	of F for 30 minutes				
			ds	ECIMEN CI	SPECIMEN CLEANING PROCEDURE B - ALUMINUM SPECIMENS	MENS	
	<u>:</u>	Acetone degrease	25				-
	ri	Descrie in 22-25 wif	14 west auffurie acte	1 with 3-4 s	sulfuric sold with 3-4 wt adichromate at 140-160' f for 10-15 minutes		
	กั	Tap water ringe	•				
	÷	Desmut in 23 V	ol 's nitric acid wil	h 1.7 Vol 3	Desmut in 23 Vol 's nitric acid with 1.7 Vol T lif at 70°F for 1 minute		
	er.	Distilled water ringe	rinse				
	Ġ.	Oven dry at 190°F for	F for 30 minutes				
			. S.	PECINES (	SPECIMEN CLEANING PROCEDURE C + NONMETALLIC SPECIMENS	PECIMENS	
	÷	Detergent wash (1 Vol	(1 Vol T. Liquinox at 70'F)	at 70 'F)			
	÷i	mailled water ringe	r(1)\$¢*				
	ë	Hot					
	÷	Oven dry at 190°F for	' f for 30 minutes				

TABLE IV ACIDS FOR CORROSION TESTS AT 120°F (1 of 2)

—-т											
Test No.	Material	Source	NTO	11 <sub>2</sub> 0	H F <u>2</u> 2	Time (days)	Temp. (°F)	Acid Type	NTO	HF Type	II <sub>2</sub> O Added
185	347/AM350 TIG Weld	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
186	ARMCO 21-6-9	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	c%
188	Cr plated 440C	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
189	Pt-Co. Alloy	Airesearch	Gn Gn	I.o	Med	7	120	WFNA-H	LM-F	Cyl.	No
190	316 ELC	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
191	NITUFF on 6061 A1	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
192	440C	Airescarch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
195	Rulon LD	Airesearch	Gn Gn	I.o	Med	7	120	WFNA-II	LM-F	Cyl.	No
196	Rulon 123	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
197	Kel-F 81	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
198	Haynes-25 Screen	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
200	17-7 PH RH 950	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
201	17-7 PH RH 1050	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-II	LM-F	Cyl.	No
226	304L/Haynes-25 Couple	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
226'	304L/Haynes-25 Couple	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-I	LM-F	Cyl.	No
227	347/Cr plated Worthite Couple	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
	:							Anna de la company de la compa			
	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	L	<u>.                                    </u>	L	L	L	L

= <0.5 Weight-Percent

0.4 to 0.8 Weight-Percent

TABLE IV (2 of 2)

Test No.	Material	Source	NTO	H <sub>2</sub> O	HF	Time (days)	Temp.	Acid Type	NTO	HF Type	II <sub>2</sub> O Added
228	302/304L Weld	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
229	17-7 PH Torque Tube	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-I	LM-F	Cyl.	No
230	356-T6/304 Couple	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-I	LM-F	Cyl.	No
231	356-T6/304L Couple	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-I	LM-F	Cyl.	No
232	6061-T6/304L Couple	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-I	LM-F	Cyl.	No
							-				

Lo = <0.5 Weight-Percent

Med = 0.4 to 0.8 Weight-Percent

TABLE V ACID ANALYSES FOR CORROSION TESTS AT 120°F (1 of 2)

Test No.	Time	HNO <sub>3</sub>	NTO (wt %)	H <sub>2</sub> O (wt %)	HF (wt %)	Fe <sub>2</sub> O <sub>3</sub> (wt %)	M <sub>2</sub> O <sub>3</sub> (wt %)	TN (wt %)	Physical Appearance
185	Pre Post	53.5	45.5	0.2	0.7	0.0001 0.0051	0.0012	0.005	Clear Many Particles
186	Pre Post	53.5	45.5	0.2	0.7	0.0001 0.0074	0.0012	0.005	Clear Many Particles
188	Pre Post	53.5	45.5	0.2	0.7	0.0001 0.0047	0.0012	0.005	Clear Clear
189	Pre Post	53.5	45.5	0.2	0.7	0.0001	0.0012 9.0036	0.005	Clear Clear
190	Pre Post	50.5	45.5	0.2	0.7	0.0001 0.0051	<b>ნ.0012</b>	0.005	Clear Clear
191	Pre Post	53.5	45.5	0.2	0.7	0.0001	0.3012	0.005	Clear OK 1
192	Pre Post	54.1	44.9	0.3	0.8	0.0004 0.0027	0.0012	0.005	Clear Clear
195	Pre Post	54.1	44.9	0.3	0.8	0.0004	0.0012	0.005	Clear OK
196	Pre Post	54.1	44.9	0.3	0.8	0.0004	0.0012	0.005	Clear Oř
197	Pre Post	54.1	44.9	0.3	0.8	0.0004	0.0012	0.005	Cle_r OK
198	Pre Post	54.5	44.6	0.2	0.7	0.9001 0.0003	0.0005	0.002	Clear Clear
200	Pre Post	54.1	44.9	0.3	0.8	9.0004 0.0074	0.0012	0.005	Clear Clear
201	Pre Post	54.1	44.9	0.3	0.8	0.0004 0.0066	0.0012	0.005	Clear Clear
226	Pre Post	54.4	44.7	0.2	0.7	0.0001 0.0009	0.0005	0.010	Clear Clear
226'	Pre Post	55.1	44.0	0.2	0.7	0.0001 0.0044	0.0004	0.010	Clear Clear
227	Pre Post	54.4	44.7	0.2	0.7	0.0001 0.0042	0.0005	0.010	Clear Clear
228	Pre Post	54.4	44.7	0.2	0.7	0.0001 0.0063	0.0005	0.010	Clear Clear

Particulate = 0.5 mg/liter

**TABLE V** (2 of 2)

Test No.	Time	HNO <sub>3</sub> (wt %)	NTO (wt %)	H <sub>2</sub> O (wt %)	HF (wt %)	Fe <sub>2</sub> O <sub>3</sub> (wt %)	M <sub>2</sub> O <sub>3</sub> (wt %)	TN (wt %)	Physical Appearance
229	Pre Post	53.4	45.7	0.2	0.7	<0.0001 0.0061	0.0007	0.003	Clear Clear
230	Pre Post	53.4	45.7	0.2	0.7	<0.0001 0.0033	0.0007 0.0076	0.003	Clear Clear
231	Pre Post	53.4	45.7	0.2	0.7	<0.0001 0.0046	0.0007 0.0066	0.003	Clear Many Particles
232	Pre Post	53.4	45.7	0.2	0.7	<0.0001 0.0%69	0.0007 0.0153	0.003	Clear Clear

TABLE VI

CORROSION TEST RESULTS - 7 DAYS AT 120°F (1 of 3)

L						Annual Company of the	Metala				Motor					
								notanana	no ja				, and			
Test	Vaterial	Source	NTO	==	o."	Physical Appearance	pearance	Corrosion Pate (Mils/Year)	rear)	Phys.	Δ Wt ?	٠,٠	5 5	(mg)	λ×s	Pating (Pefer
ģ ]				4	শ্	Vajor	L.lquitd	Vapor	Liquid	ig 🗟	ห <sub>2</sub> 03	Fe <sub>2</sub> O <sub>3</sub>	Vanor	L.tquid	(fn. <sup>-1</sup> )	Tuble II)
185	347/AM350 TIG Weld	Afrescarch	Gn Gn	Ned	3	l	White Corrosion Products in the beliaws: AM 350 welds were etched (7)	ŀ	3.1	a (§)	1	0.0050	i	(2)	1.0	AM350 III
35 25	21-6-9	Alresvarch	ea Ga	Med	3	Light Green Corrosion Products on faces, White Corrosion Products in hole, No effect on metal (7)	Light Green Corroston Products. No effect on metal (1)	8.0	61 61	જ હ	;	0.0073	(5)	(5)	0: 7	8
## ##	Cr plated	Airenearch	Gn Gn	Med	2	:	Flaking of plating (3)	1	i	Clear (1)	;	0.0046	:	30.1	<u>.</u>	2
<u>8</u>	Pt-Co Alloy	Airesearch	Gn Gn	Med	L.o.	;	Blue-Black Color, Some attack (4)	;	8:0	Clear (2)	0.0024	1 1	ì	9.6	0.1	-
	314 ELC	Airesearch	G	Med	5.1	Gray Stains; No effect on metal (3)	Light Green Corrosion Products: No effect on metal (7)	9.0	မ က	Clear (1)	i	0.0050	24.4	11.8 (6)	9.	=
<u> </u>	NITUFF on 6001 AI	Airesearch	G G	Med	3	;	Irridescent, Some attack on metal (2)	1	;	£ 6	i	:	-	8.3 C	0.1	=
761	+40C	Airestarch	5	Med	l.o	White Corrosion Products; Pits, Etched (8)	White Corrosion Products; Pits; Etched (3)	9.	£.3	Clear (3)	i	0.0023	9,7 (8)	2,6	1.0	<b>=</b>
195	Rulon 1.D	Airesearch	e e	Med	<u> </u>	∢	4	∢	€	匂	匂	৶	✐	∢	€	∢
196	Rulon 123	Airescarch	Cu Cu	Med	0.	৶	4	⊴	⊴	৶	↲	∢	⊲	∢	∢	eq
197	Kel-F 41	Airesearch	5 5	Med	lo.	€	4	∢	$\triangleleft$	$\triangleleft$	৶	$\triangleleft$	◈	∢	∢	∢
601	Haynes-25 Serven	Bell Acrospace	5 cg	Med	3	ļ	No effect on metal	1	8.6	Clear (2)	;	0.0002	:	38	0.1	=
200	17-7-PH HH 950	Atresearch	Gn Gn	Med	2	White Corrosion Products, Eiched (7)	White Corrosion Products, Etched (7)	2.0	6) 6)	Clear	;	0.0070	(2)	15.2	0.1	=
						otto estimate e estimate in the sales and sales de la constant de la constant de la constant de la constant de		4		<b></b>		T	4			

Med • 0.4 to 0.8 Weight-Percent

3 "Numbers in parentheses refer to applicable computer code. Refer to Table VII for definition
4 "Refer to sheet 3 of 3 for test results applicable to nonmetals

TABLE VI (2 of 3)

Γ				Γ			Metula				Actd					
								Corrosion	ston				Deb	Deposits		
Test	Material	Source	NTO	<u>+</u>	o²=	Physical	Physical Appearance	Rate (Mils/Year)	(e Year)	phy4.	A Wt '5.		5		> 7	Rating (Refer
Se				⊌	_ _	v.mor	Liquid	Vapor	Liquid	ė d	M203	Fe <sub>2</sub> O <sub>3</sub>	Vupor	Liquid	(ja.	To Table II)
201	17-7 PH HH 1050	Airesearch	Gn Gn	Med	ន	White Corrosion Products, Etched (7)	White Corrosion Products, Etched (7)	7.0	3.0	Clear 3)	;	0.0062	23.2	35.0 (2)	0.1.0	=
226	3041./	Mell Aerospace	no eo	Med	2	1	No Effect (1)	:	1,3	Clear	;	0.0008	1	0.7 (£)	1.0 (Total)	=
	Haynes-25 Couple						Etched (5)	:	16.0	·			1	£. €		=======================================
226'	3041/	Bell Aerospace	Cu Gu	Med	្ន	!	No Effect (1)	:	0.1	Clear	;	0.0043	:	•	1.0 (Total)	=
	Haynes-25 Couple					:	No Effect (1)	;	~	<u>.</u>			!	0		=
227	7446	Bell Aerospuce	Gn Gn	Med	10	i	Etched (5)		2.4	Clear	i	6.0041		8.3	1.0 (Total)	=
	Cr Plated Worthite Couple					!	No Effect (1)	:	10.0>				:	9.7		
£2.53	302/3041. Weid	Rell Aerospace	ch ch	Med	2	:	302 Etched (5)	;	4.4 (Total)	Clear (1)	;	0.0062	;	3.6	0.1	=
229	17-7 PH Torque Tube	Bull Aerospace	Gh Gn	Med	ន	:	White Salts in Tube	ŀ	4.	Clear (E)	;	0,000,0	i	3.8 (3)	0,1	=
230	356-70/	Bell Aerospace	da Ga	Med	2	White Salts in	White Salts in	1.9	3.4	Clear	6900.0	0.0032	5.1	8.6 8.6	1.0 (Total)	=
	304 Couple					author to course	(2)	5.1	1.9	;			3.6	(S)		=
162	356-76/	Bell Aerospaen	ca Ga	Med	្ន	White Salls in	White Salts in	3,4	7.	<u>, 6</u>	0,0059	0.0045	6.3	8.5	1.0 (Total)	=
	no41. Couple					(4)	¢.	4.5	9.0			*	5.2 (§	5.2 (3)		=
333	Anodized (112504)	Bell Aerospace	Ch Ch	Med	o,	Anodize OK except for White Salts in	Anodize OK except for White Salts in	0.1	3.6	Clenr (1)	0.0146	0.0068	7.6 (2)	I @	1.0 (Total)	=
	304L Couple							g:0	0.5				5.5 0.4 (inc. Al salts)	0.4 anita) (1)		-

0.4 to 0.8 Weight-Percent <0.5 Weight-Percent

- · · ·

Med ... O.4 to 0.18 Weight-Percent Lo ... <0.5 Weight-Percent Numbers in parentheses refer to applicable computer code. Refer to Table VII for definition.

TABLE VI (3 of 3)

						Compatibility Test Results - Nonmetals	tosuits -	Nonmetals Plast	etals Plastic Physical Properties	roperties		Ac	Acıd	Rating	
Test No.	Material	Source	мто	# <	11 <sub>2</sub> 0	Physical Appearance	Weight ( A %)	Volume (△ ¾)	Hardness (Shore D Units)	Width ( △ In.)	Thickness ( $\Delta$ In.)	Phys.	Particulate (mg/liter)	(Refer To Table II)	
961	Rulon L.D	Airesearch	Gn Gn	Med	Lo	Color change, red to gray (4)	+2.86	47.29	?-	+0.0083	\$900°0+	OK (3)	0.8	11	
190	Ruton 123	Airesourch	en G	Med	2	Surface change, smooth to rough (5)	+7.57	+8.03	Ÿ	+0.0103	+0.0062	ş ē	0.3	=	
101	7. 	Asreserch	ច ច	Pow	3	Color change, white to amber (4)	11.12	+1.49	ų.	•	+0.0009	ŏ €	1.0	=	
 		0.4 to 4.8 Weight-Percent <0.5 Weight-Percent arentheses refet to applical	-Porcent sent o applicab	le comput	ter code.	Med = 0.4 to 0.3 Weight-Percent 1.0 = <0.5 Weight-Percent Numbers in parentheses refer to applicable computer code. Refor to Table VII for definition.	· definition.				-			Afternative of the second seco	ר

TABLE VII
HDA CORROSION TEST COMPUTER CODE

	Acid	(3	Material Specify Worst Case)		orrosion Products ify Predominant Color)
Code	Appearance	Code	Worst Case	Code	Color
(1)	Clear	(1)	N.E. (No Effect)	(1)	Colorless
(2)	Discolored	(2)	Iridescent	(2)	White
(3)	о.к.	(3)	Streaks	(3)	Violet
(4)	Particles	(4)	Discolored or Disfigured	(4)	Indigo
(5)	Many Particles >P	(5)	Etched	(5)	Green
(6)	Cloudy	(6)	Severe Etch	(6)	Blue
		(7)	Corrosion Products	(7)	Yellow
		(8)	Pits	(8)	Orange
		(9)	Plating Flakes	(9)	Brown
		(10)	No Inhibition	(10)	Red
				(11)	Black

TABLE VIII

ACIDS FOR BAC SPONSORED CORROSION TESTS AT 120°F

Test No.	Material	Source	NTO	H <sub>2</sub> O ∕1\	HF	Time (days)	Temp.	Acid Type	NTO	HF Type	H <sub>2</sub> O Added
182	5454 H-32 Al	Fruehauf	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
183	5454 H-32 Al Welded	Fruehauf	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
184	5454-0 Al	Fruehauf	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
193	5086 Al	Fruehauf	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
194	5086 Al Welded	Fruehauf	Gn Gn	I.o	Med	7	120	WFNA-H	LM-F	Cyl.	No
154	6061 T-6 Al	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-B	LM-F	Cyl.	No
153	6061 T-6 Al Welded	Bell Aerospace	Gn Gn	Lo	Med	7	120	WFNA-F	LM-F	Cyl.	No
190	316 ELC	Airesearch	Gn Gn	Lo	Med	7	120	WFNA-H	LM-F	Cyl.	No
						•					

Ŵ

Lo = <0.5 Weight-Percent

Med

Med = 0.4 to 0.8 Weight-Percent

TABLE IX  ${\tt ACID\ ANALYSES\ FOR\ BAC\ SPONSORED\ CORROSION\ TESTS\ AT\ 120°F }$ 

		TINO	MEC	и о	ur	Fo O	14.0	my	
Test	Time	HNO <sub>3</sub> (wt %)	NTO (wt %)	H <sub>2</sub> O (wt %)	HF (wt %)	Fe <sub>2</sub> O <sub>3</sub> (wt %)	M <sub>2</sub> O <sub>3</sub> (wt %)	TN (wt %)	Physical Appearance
No.		(WL 10)	(WE 10)	(WC 70)	(WE 70)	(WL 10)	(WC 10)	(WL /0)	Appearance
182	Pre	<b>53.</b> 5	45.5	0.2	0.7	0.0001	0.0012	0.005	Clear
	Post						0.0014	i	Clear
183	Pre	53.5	45.5	0.2	0.7	0.0001	0.0012	0.005	Clear
	Post						0.0012		Clear
184	Pre	53.5	45.5	0.2	0.7	0.0001	0.0012	0.005	Clear
	Post						0.0012		OK
193	Pre	54.1	44.9	0.3	8.0	0.0004	0.0012	0.005	Clear
	Post						0.0016		OK
194	Pre	54.1	44.9	0.3	0.8	0.0004	0.0012	0.005	Clear
	Post						0.0017		OK
154	Pre Post	55.0	44.1	0.1	0.8	0.0003	0.0005 0.0030	0.002	Clear Clear
	•								
153	Pre Post	53.1	45.9	0.3	0.7	0.0001	0.0008 0.0034	0.001	Clear Clear
190	Pre Post	53.5	45.5	0.2	0.7	0.0001 0.0051	0.0012	0.005	Clear Clear
لــــــــــــــــــــــــــــــــــــــ			i						

TABLE X

_															
	Rating (Refer	Table II)		-	<b>-</b>	-	_	<b>-</b>	_	=					
	3	(B. 1.	1.0	1.0	1.0	1.0	3.0	1.0	1.0	0.1					
	eits ()	Liguid	0.7 (f)	0.6	0.5	: ខ	3.6	;	5.3	(5)					
	Depo	Vapor	8, 5	9.13	38	2.5	3.6	e ê	5.2 (3)	24.4					
	Vt 7	Fe2O3		!	!	;	:	ŀ	:	0.005					
Acid	۷ ۵	M203	0.0002	< 0.0001	, 0,0001	0.0004	0.0005	0.0025	0.0026	!					
	Phys.	<u></u>	Clear (1)	Clear (2)	OK (3)	OK (3)	OK (3)	Clear (3)	Clear (1)	Clear (1)					
	sion c Year )	L.fqufd	0.1	<0.1	6:3	6.1	9.2	< 0.1	0.2	5; 5;					
	Corro Rat (Mils/	Vapor	< 0.1	< 0.1	16.1	0.1	.6.	70 V	< 0.1	9.0	<del></del>	<del></del>			
		€	8	£	£	(f)	3	æ	£	roducts					
Metals	pearance	1.1quid	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	Light Green Corrosion P on metal (7)					
	ystent Ap	<b>(</b>	â	ŧ	e e	€	æ	€	Ē	s: No etal					
	ā	Vapor	No Effect	No Effect	No Effect	No Effect	No Effect	Discolored	Discolored	Gray Stain effect on m (3)					
	I : :	- - -	0.1	3	្ន	o.i	2	c,	9	<u>s</u>					
			Med	Ned	Med	Med	Med	paw	Med	Med				· · · · · ·	
	Ş		Gn Gn	5 5	Gn Gn	:5 :5	en G	Gn Cn	Cn Gn	ຕິກ					
	3	33 1000	Fruchauf	Fruchauf	Fruchauf	Frachauf	Fruehauf	Bell Aerospace	Bell Aurospace	Airescarch					-
	Majorial		5454 11-32	5454 11-32	0-121-0	5086 A)	Sest Al Wei fed	6061 T-6	6061 T-5 Welded	3, 3 ELC					
	Į.	χ. Ĉ	25	1.93	184	193	F61	154	153	061					
		Metals Corrosion Acid Deposits  Physical Appearance Rate Phys. A Wt 7 (mg) SAN	H <sub>2</sub> O   Vapor   A   Liquid   A   Vapor   A   V	Material   Source   NTO   IIF   11_2	Metala         Source         NTO         IIF         III         III         Metala         Appearance         Corrosion         Pape         Appearance         Rate         III         III         III         Appearance         Corrosion         Appearance         III         III         III         III         III         III         III         Appearance         III         III         III         III         III         Appearance         III         III         Appearance         III         III         III         III         III         Appearance         III         III         Appearance         III         III         Appearance         III         III         Appearance         III         III         III         III         Appearance         Appearance         III         III	Metalis         Act of this colspan="4">Act of	Material         Source         NTO         IIF         II, 0         Physical Appearance         Corrosion         Pape         App.         App.	Material         Source         NTO         IIF         II_Q         Physical Appearance         Corrosion         Phys.         A Wt T         Amount T mgs         Amount T mgs <t< td=""><td>  Miterial   Source   NTO   IF     120</td><td>  Miderial   Snurce   NTO   IT   ILO     Physical Appearance   Corrosion   Physical Appearance   Physical Ap</td><td>  Sharter   Shar</td><td>  Miderial   Sauree   NY   IIP   II   II   II   II   II   II  </td><td>  Secretary   Secr</td><td>  Source   Source   String   Source   String   Source   String   Source   String   Source   String   Source   String   S</td><td>  Miderial   Source   NTO   IF   I<sub>1</sub>O   Name   Phypical Appearance   Corresion   Order   ANT   TITES   ANT   TITE</td></t<>	Miterial   Source   NTO   IF     120	Miderial   Snurce   NTO   IT   ILO     Physical Appearance   Corrosion   Physical Appearance   Physical Ap	Sharter   Shar	Miderial   Sauree   NY   IIP   II   II   II   II   II   II	Secretary   Secr	Source   Source   String   Source   String   Source   String   Source   String   Source   String   Source   String   S	Miderial   Source   NTO   IF   I <sub>1</sub> O   Name   Phypical Appearance   Corresion   Order   ANT   TITES   ANT   TITE

Med \* 0.4 to 0.8 Weight-Percent 1.0 \* c0.5 Weight-Percent Sumbers in parentheses refer to applicable con "ter code. Refer to Table VII for definition. 

是有一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种的一种,我们就是一种,我们就是一种的一种,我们们就是一种的

TABLE XI
ACIDS FOR CORROSION TESTS AT 220°F

Test No.	Material	Source	NTO	H <sub>2</sub> O	HF	Time (days)	Temp.	Acid Type	NTO	HF Type	H <sub>2</sub> O Added
221	356-T6	Bell Aerospace	Gn Gn	Lo	Med	6	220	WFNA-H	LM-F	Cyl.	No
222	356-T6 Hard Anodized	Bell Aerospace	Gn Gn	Lo	Med	6	220	WFNA-H	LM-F	Cyl.	No
223	304L	Bell Aerospace	Gn Gn	Lo	Med	6	220	WFNA-H	LM-F	Cyl.	No
224	AM350	Bell Aerospace	Gn Gn	Lo	Med	6	220	WFNA-H	LM-F	Cyl.	No
225	Anodized 6061-T6/304L Couple	Bell Aerospace	Gn Gn	Lo	Med	6	220	WFNA-H	LM-F	Cyl.	No

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Lo = <0.5 Weight-Percent

 $\overline{\mathbb{A}}$ 

Med = 0.4 to 0.8 Weight-Percent

TABLE XII  $\label{eq:acid} \mbox{ACID ANALYSES FOR CORROSION TESTS AT 220}^{\rm c} \mbox{F}$ 

Test No.	Time	HNO <sub>3</sub> (wt %)	NTO (wt <sup>©</sup> )	H <sub>2</sub> O (wt %)	HF (wt %)	Fe <sub>2</sub> O <sub>3</sub> (wt %)	M <sub>2</sub> O <sub>3</sub> (wt %)	TN (wt %)	Physical Appearance
221	Pre Post	54.4	44.7	0.2	0.7	0.0001	0.0005 0.0011	0.010	Clear Clear
222	Pre Post	54.4	44.7	0.2	0.7	0.0001	0.0005 0.0024	0.010	Clear Many Particles
223	Pre Post	54.4	44.7	0.2	0.7	0.0001 0.0019	0.0005	0.010	Clear Clear
224	Pre Post	54.4	44.7	0.2	0.7	0.0001 0.0011	0.0005	0.010	Clear Clear
225	Pre Post	54.4	44.7	0.2	0.7	0.0001 0.0021	0.0005 0.0056	0.010	Clear One Large Particle
					Parameter (Parameter (				
								Parameter of Param	
A the same of the									
								Andreas Andrea	
				AND THE PROPERTY OF THE PROPER					
					Talangan katalangan katalangan katalangan katalangan katalangan katalangan katalangan katalangan katalangan ka				
	To design the second se	Mary Control of the C			WINDS AND THE PROPERTY OF THE				
Pro-Application of the Application of the Applicati		And the second s					The desiration of the state of		
	Antiquitation description of the state of th	Smarries - A - A - A - A - A - A - A - A - A -		Printing printing space of the					
						!			

TABLE XIII

CORROSION TEST RESULTS - 6 HOURS AT 220°F

		~						<del></del>
	Rating	Table II)	=	2	=	E	=	_
	νs	(fn1)	0.1	1.0	1.0	1.0	(Total)	
	e ;	Liquid	•	17.5	2.8	21.1	18.5	e <del>e</del>
	Deposits (mg)	Vapor	0.1 (f)	6.9	1.8	8.8	\$8	6.5
	D Wt %	17e2O3	į	;	0.0018	0.0010	0.0020	
Acid	٥	KO2W	9000°0	0.0019	i	!	0.0051	
	phys.	·de 🤇	Clear (1)	(g) d <	Clear (1)	Clear (1)	One Large Particle (4)	
	Corrosion Rate Mile/Year)	Liquid	1.4	-550 -1106 > P (Weight and volume increase)	2.4	16.0	0.0	9.0
	Corrosion Rate (Mila / Year	Vapor	2.8	-550 (Weight a	3.6	ۍ ث	1.3	9.0
		∌	ê	om black	£	ε	(5)	ê
Metals	vrance	Liquid	No Effect	Menched from black to gray (4)	No Effect	No Effect	Anodize Removed in Crevice (5)	No Effect
	Physical Appearance	@			e		<u> </u>	
	Phy	Vapor	Discolored-dull	[Macolored- blacker	No Effect	Discolored '4)	Anodize Removed in Crevice	No Effect (1)
	 0°2	. 🚳	Lo	3	3	o,	ro Lo	
	#F	$\bigcirc$	Med	Med	Med	Med	Med	
	NTO		Gn Gn	60 GB	G G	g g	ติก ติก	
		Source	Boll Aerospace	ikil Acrospace	Bell Aerospace	Dell Aurospace		Ball Aerospace
		Matorini	356-TG	356-T6 Hard Anodized	3041.	AM 350	Anodizad 6061 -TG/	Couple
	Test	ν. Vo.	221	222	223	462	225	

0.4 to 0.8 Weight-Percent <0.5 Weight-Percent

As an analysis weight-Percent is a co.5 Weight-Percent is a contact of the computer code. Refer to Table VII for definition.

When the second of the second second

TABLE XIV ACIDS FOR CORROSION TESTS AT  $90^{\circ}F$  (1 of 2)

Test	Material	Sauraa	NTO	H <sub>2</sub> O	HF	Time	Temp.	Acid	NTO	HF	н <sub>2</sub> о
No.	Materiai	Source	NIO	$\Lambda$	2	(days)	(°F)	Туре	NIO	Туре	Added
203	6061-T6	Bell Aerospace	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
204	347 SS	Bell Aerospace	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
205	Columbium C-103 ( <u>W</u> R512E Coat)	TRW	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
206	17-7 PH Full Annealed (Condition A)	TRW	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
207	Au/Ni Braze Alloy	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM·F	Cyl.	No
208	17-7 PH RH 1050	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
209	Rulon A	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
210	AM350 Screen	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
211	304L	LMSC	Gn Gn	Lo	Med	50	90	WFNA-H	LM-F	Cyl.	No
212	321/321 Bellows-Welded	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	I.M-F	Cyl.	No
214	321/321- 347 Filler-Weld	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
215	304/304- 308 Filler-Weld	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
216	356A Cast	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
217	356 <b>-</b> T6	Bell Aerospace	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
218	321	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
219	304L Work Hardened	TRW	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
220	25% Glass Filled Teflon	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
233	Kel-F 5500	Bell Aerospace	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
234	Kel-F 81	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
235	Rulon LD	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
236	Rulon 123	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
					<u> </u>	l	<u> </u>				

Lo = <0.5 weight-percent

Med

= 0.4 to 0.8 weight + percent

TABLE XIV (2 of 2)

				н,0	HF	Time	Temp.				Н <sub>о</sub> О
ſest	Material	Source	NTO	-		(days)	(°F)	Acid	NTO	HF	ž.
No.					2			Туре		Туре	Added
237	17-7 PH Torque Tube	Bell Aerospace	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
238	304L	Bell Aerospace	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
239	440C	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
240	Armco 21-6-9	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
241	20-Cb-3	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
242	Chromized Haynes - 25	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
243	Chromized 440C	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
244	2021/2021 Weld	LMSC	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
245	2219/2219 Weld	LMSC	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
246	M-50 Alloy	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No.
247	316 Spring Wire	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
248	17-4 PH H 1025	LMSC	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
249	17-7 PH Spring Wire	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
250	Rh plated Haynes - 25	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-H	LM-F	Cyl.	No
251	Rh plated 440C	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
253	MP-35-N	Airesearch	Gn Gn	Lo	Med	60	90	WFNA-I	LM-F	Cyl.	No
253	304L/304L Tig Weld	Airesearch	Gn Gn	I.o	Med	60	90	WFNA-I	LM-F	Cyl.	No
254	347/347 Tig Weld	Airesearch	Gn Gr	I,o	Med	60	90	WFNA-I	LM-F	Cyl.	No

**A** 

Lo = <0.5 weight - percent

Med = 0.4 to 0.8 weight - percent

TABLE XV  ${\rm ACID \; ANALYSES \; FOR \; CORROSION \; TESTS \; AT \; 90°F \; \; (1 \; of \; 3) }$ 

Test	Time	HNO <sub>3</sub>	NTO	H <sub>2</sub> O	HF	Fe <sub>2</sub> O <sub>3</sub>	M <sub>2</sub> O <sub>3</sub>	TN⁵	Physical
No.		(wt <sup>cy</sup> )	(wt F)	(wt %)	(wt %)	(wt %)	(wt %)	(wt %)	Appearance
203	Pre Post	55.6	43.5	0.2	0.7	0.0002	0.0006 0.0014	0.010	Clear A few particles
204	Pre Post	55.6	43.5	0.2	0.7	0.0002 0.0039	0.0006	0.01	Clear Clear
205	Pre Post	55.6	43.5	0.2	0.7	0.0002	0.0006 0.6985	0.016	Clear Dark green, cloudy
206	Pre Post	55.6	43.5	0.2	0.7	0.0002 0.0035	0.0006 0.0147	0.010	Clear Clear
207	Pre Post	55.6	43.5	0.2	0.7	0.0002	0.0006 0.5178	0.010	Clear Light green liquid
208	Pre Post	55.6	43.5	0.2	0.7	0.0002 0.0011	0.0006 0.0577	0.010	Clear Clear
209	Pre Post	55.6	43.5	0.2	0.7	0.0002	0.0006	0.010	Clear Clear 1
210	Pre Post	55.6	43.5	0.2	0.7	0.0002 0.0009	0.0006	0.010	Clear Clear
211	Pre Post	55.6	43.5	0.2	0.7	0.0002 0.0037	0.0006	0.010	Clear Clear
212	Pre Post	53.7	45.3	0.2	0.8	0.0001 0.0016	0.0007	0.010	Clear Many large particles
213	Pre Post	53.7	45.3	0.2	0.8	0.0001	0.0007 0.5177	0.010	Clear Many particles
214	Pre Post	53.7	45.3	0.2	0.8	0.0001 0.0021	0.0007	0.010	Clear Many fine particles
215	Pre Post	53.7	45.3	0.2	0.8	0.0001 0.0934	0.0007	v.010	Clear Many fine particles
216	Pre Post	53.7	45.3	0.2	0.3	0.0001	0.0007 0.0020	0.010	Clear Clear
217	Pre Post	53.7	45.3	0.2	0.8	0.0001	0.0007 0.0016	0.010	Clear A few particles
218	Pre Post	53.7	45.3	0.2	0.8	0.0001 0.0023	0.0007	0.010	Clear Many fine particles
219	Pre Post	53.7	45.3	0.2	0.8	0.0001 0.0054	0.0007	0.010	Clear Many fine particles
220	Pre Post	53.7	45.3	0.2	0.3	0.0001	0.0007	0.010	Clear OK 2
L				Mia				<u></u>	



Particulate = 0.1 mg/liter

Particulate = 3.3 mg/liter

TABLE XV (2 of 3)

Test No.	Time	HNO <sub>3</sub> (wt %)	NTO (wt %)	H <sub>2</sub> O (wt %)	HF (wt %)	Fe <sub>2</sub> O <sub>3</sub> (wt %)	M <sub>2</sub> O <sub>3</sub> (wt %)	TN (wt %)	Physical App <b>e</b> arance
233	Pre Post	53.4	45.7	0.2	0.7	0.0001	0.0007	0.003	Clear Clear 1
234	Pre Post	53.4	45.7	0.2	0.7	0.0001	0.0007	0.003	Clear Clear 1
235	Pre Post	53.4	45.7	0.2	0.7	0.00 <sup>†</sup> 01	0.0007	0.003	Clear Clear 1
236	Pre Post	53.4	45.7	0.2	0.7	0.0(/01	0.0007	0.003	Clear Clear 3
237	Pre Post	53.4	45.7	0.2	0.7	0.0001 0.0042	0.0007	0.003	Clear Clear
238	Pre Post	53.7	45.4	0.2	0.8	0.0,102 0.0 <sup>5</sup> 61	0.0008	0.010	Clear Clear
239	Pre Post	53.7	45.4	0.2	0.8	0.002 0.0061	0.0008	0.010	Clear Many fine particles
240	Pre Post	53.7	45.4	0.2	0.8	0.0002 0.0056	0.0008	0.010	Clear Many large particles
241	Pre Post	53.7	45.4	0.2	0.8	0.0002 0.0009	0.0008	0.010	Clear Many fine particles
242	Pre Post	53.7	45.4	0.2	0.8	0.0002	0.0008 0.2721	0.010	Clear Dark, green, black liquid
243	Pre Post	53.7	45.4	0.2	0.8	0.0002	0.0008 18.4916	0.610	Clear Dark, green, black liquid
244	Pre Post	53.7	45.4	0.2	0.8	0.0002	0.0008 0.0440	0.010	Clear Many particles
245	Pre Post	53.7	45.4	0.2	0.8	0.0002	0.0008 0.0311	0.010	Clear Many particles
246	Pre Post	53.4	45.7	0.2	0.7	0.0002 0.0066	0.0007	0.003	Clear Many particles
247	Pre Post	54.4	44.6	0.2	0.7	0.0001 0.0048	0.0005	0.010	Clear Clear
248	Pre Post	54.4	44.6	0.2	0.7	0.0001 0.0071	0.0005	<b>ə.010</b>	Clear Clear
249	Pre Post	54.4	44.6	0.2	0.7	0.0001 0.0045	0.0005	0.010	Clear Clear

Particulate = 0.1 mg/liter

Particulate = 0.2 mg/liter

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TABLE XV (3 of 3)

	· · · · · · · · · · · · · · · · · · ·								
Test No.	Time	HNO <sub>3</sub>	NTO (wt %)	H <sub>2</sub> O (wt %)	HF (wt <sup>c</sup> r)	Fe <sub>2</sub> O <sub>3</sub> (wt $^{c}$ )	M <sub>2</sub> O <sub>3</sub> (wt %)	TN (wt %)	Physical Appearance
250	Pre Post	54.4	44.6	0.2	0.7	0.0001	0.0005 0.5720	0.010	Clear Dark red liquid, many particles
251	Pre Post	53.8	45.3	0.2	0.7	0.0001	0.0004 0.4640	0.010	Clear Green liquid, many particles
252	Pre Post	53.8	45.3	0.2	0.7	0.0001	0.0004 0.3780	0.010	Clear Darkened liquid, many particles
253	Pre Post	53.8	45.3	0.2	0.7	0.0001 0.0021	0.0004	0.010	Clear Many, many, fine and large particles
254	Pre Post	53.8	45.3	0.2	0.7	0.0001 0.0015	0.0004	0.010	Clear Many, many large particles
				Managan da					
					Anthropinion and the control of the				
				ANGELIE ANGELIE ANGELIE ANGELIE	indian Complete Compl		And the state of t		
			degle e <sup>t</sup> elementere <sub>L</sub> eitensteinen.	Manual Assistance of the Assis					
	<u> </u>	<u> L</u>	<u></u>	<u></u> _	<u></u>	<u></u>	L		l

TABLE XVI

Vicinity of the Audit of the Control of the Control

## CORROSION TEST RESULTS - 60 DAYS AT 90°F (1 of 5)

ſ														1
**************************************		Rating (Refer	Table II)	-		=	-	E	=	∢	=	_	=	
		λ/s	(h. '1	1.0	1.0	1.0	1.0	1.0	0.1	∢	1.0	1.0	0.1	
		posits (mg)	Liquid	9.2	3.7	32.8	11.0	17.0	64.3	∢	50.7	9.3 (1)	134	
	· 	Deposits (mg)	Vapor	0.3	23.1	!	!	:		$\triangleleft$	78.6 (5)	50.4 (5)	302	
,		7. Y	Fe <sub>2</sub> O <sub>3</sub>	<u> </u>	0.0037	!	0.0033	:	6,0009	∢	0.0007	0.0035	0.0015	
(0 70 7)	Aeid	W &	M <sub>2</sub> O <sub>3</sub>	0.0008	:	0.6979	0.0141	0.5172	0.0571	∢	;	:	!	
4 00		Phys.	∳	S 6	Clear (1)	Dark Green, Cloudy (6)	Clear (1)	Clear Green Liquid (2)	Clear (1)	<b>(</b>	Clear (t)	Clear (1)	۲. ق	
		Coresistan Rate (Mils/Year)	1.tqutd	7 0.1	9.0	11.0	0.7	10.0	£. 0	◈	1.0	6.0	*	
וש מושת הה		Corroston Rate (Mils/Year	Vapor	<b>√ 0.1</b>	5.0	!	;	i	i	∢	6.4	0.3	9.0	
1	Metals	anu	Liquid 🐴	Slight Tarnish (4)		Green Corrosion Products: metal eteched (7)	White Corrosion Products: metal etched (7)	Severely etched (6)	Green Corrosion Products: pits, etched (8)	⋖	Green Corrosion Products:No effect on metal (7)	No Effect (1)	White Corrosion Products: HAZ and tack welds etched (7)	
1		Appeara		Sligh	- E	Orec Prod etche	White C Product etched	Seven	Green C Product etched		Green Co Products on metal	8 8	Prod tack	\ \
CORROSION LEST RESOLLS		Physical Appearance	Vapor 🙈	Slight Tarnish (4)	White Corrosion Products. No effect on metal (7)	!	;	:	<b>!</b>	∢	Green Corrosion Products No effect on metal (7)	Green Corrosion Products: No effect on metal (7)	White Corrosion Products, IIAZ and tack welds etched (7)	
Z PA PA		S,	୍≪	1.0	2	3	<u> </u>	3	5		<u>.</u>	<u>s</u>	9	
,		=	-€	Med	Med	Med	Med	Med	Med	Med	Med	Med	Med	
		STO		Gn Gn	5 5	g g	ug ug	an Gr	5 5	es es	5	5 5	5 6	
		Source		ikil Aerospace	Bell Aerospace	TRW	TRW	LMSC	1.MSC	Airosenrch	LMSC	гияс	LMSC	
		Material		91-1909	347 SS	Cb C-103	17-7 PH Full Annealed (Condition A)	Au/N: Braze Alloy	17-7 PH RH 1650	Rulon A	AM 350 Sereen	3041.	321/321 Welded Bellows	
		7 cst	%	203	102	505	902	207	<b>\$07</b>	802	210	2111	3 0	]

Med 0.4 to 0.3 Weight-Percent

Lo ' <0.5 Weight-Percent

A Numbers in parentheses refer to applicable computer code. Refer to Table VII for definition.

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TABLE XVI (2 of 5)

Γ	-4 24	£						<del></del>								
L	Rating	To Table II)	=	=			=	=	$\triangleleft$	$\triangleleft$	$\triangleleft$	⋖	$\triangleleft$	<u>-</u>	-	=
	Ş	(fn. <sup>-1</sup> )	0 1,	1.0	1.0	1.0	0.1	0:	$\triangleleft$	$\triangleleft$	⊲	$\triangleleft$	∢	0.1	1.0	0.1
	Deposits (mg)	Liquid	8 (5)	£ 6j	58	÷	₹£	3.2	∢	⊴	⊴	⊴	∢	1.0	33	266.0
	Depo (m	Vapor	(g)	g <u> </u>	-ŝ	<b>4</b> €	§ §	!	$\triangleleft$	∢	⊲	∢	∢	;	(2)	200.0
	A Wt %	$^{\mathrm{Fe}_{2}\Omega_{3}}$	0.0020	0.0033	!	į	0.0022	0.0053	$\triangleleft$	$\triangleleft$	⊴	⊲	$\triangleleft$	0.0041	0.0059	0.0059
Actd	۸۵	M <sub>2</sub> O <sub>3</sub>	ŀ	:	0.0013	0.0000	;		$\triangleleft$	$\triangleleft$	$\triangleleft$	⊴	⊴		1	:
	Phys.	Λρρ.	ط× (ق)	d &	Clear (1)	Ş <u>6</u>	ر ق	ر رق (ق	⊴	∢	⋖	$\triangleleft$	∢	Clenr (1)	Clear (3)	۲× (ق)
	Corrosion Rate (Mils/Year)	Liquid	8.0	5.0	5:0	2.0	6.0	0.5	∢	$\triangleleft$	$\triangleleft$	∢	∢	0.7	0.5	1.7
	Corr Rn (MU)	Vapor	6.0	0.2	0.1	ਰ: 0	0.4	1	∢	⊲	<b>⊘</b>	$\triangleleft$	∢		2.0	 .:
Metals	ppearunce	Liquid 🖄	White Corrosion Products: Cut end attack (7)	Light Green Corrosion Products; end grain attack (7)	Discolored (4)	No Effect (1)	Metal elched (5)	Etched (5)	∢	4	∢	∢	∢	Light Green Corrosion Products (7)	No Effect	White Carroston Products: etched (7)
	Physical Appearance	Vapor 🐴	White Corrosion Products, Cut end attack (7)	Light Green Corrosion Products; end grain attack (7)	Discolored - black (4)	Discolored (4)	Green Corrosion Products (7)	!	⊲	$\triangleleft$	∢	∢	∢	ŀ	White Corrosion Products (7)	White Corresion Products; etched, pits (*)
	H <sub>2</sub> O	•	Lo	3	S.	6,1	l.o	Lc	្ម	c.I	0.1	0.1	l.o	l.o	٥:	Lo
	AH	lacksquare	Med	Med	Med	Med	Mrd	Med	Med	Med	Med	Med	Med	Med	Med	Med
	NTO		On Gn	g g	Gu Gu	Gh Gh	Gn Gn	Gn Sn	Gn Gn	ch Gh	Ch Ch	69 69 69	Gn Gn	Gn Ga	ng ng	ຕິ ຕິ
	Source		LMSC	LNSC	LMSC	[kt] Aerospace	LMSC	TRW	гивс	Bell Aerospace	Airesenrch	Alresearch	Airesonrch	Bell Aeroupace	Nell Acrospace	Airmenrch
	Material		321/321- 347 Filler Weld	304/304- 309 Fillor Weld	355 A Cast	329-126	321	3041. Work Hardened	25'6 Glass Filled Teflon	Kel-F 5500	Kel-F st	Rulon 1.D	Rulon 123	17-7 PH Torque Tube	304L	44W.
	Test	%	+12	# <u>0</u>	316	217	218	219	130	233	234	235	236	237	£.	239

Numbers in parentheses refer to applicable computer code. Refer to Table VII for definition.

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0.4 to 0.8 Weight-Percent

co.5 Weight-Perent Med Lo

TABLE XVI (3 of 5)

						1	Metals	Corrosion	lon		Acid		Deposits	lts.		
Tost Material Source NTO HF H2O	NTO HF	<u>-</u>		= 2	0	Physical	Physical Appearance	nate (Mile/Year)	car)	phys.	A Wt &	.5	- <u>-</u> - →		s/s	Rating (Refer
				⊗	_	Vapor 🖎	Liquid 3	Vapor	L. Iquid	4	$M_2O_3$	Fe <sub>2</sub> O <sub>3</sub>	Vapor ©	1.iquid	(In1)	To Table II)
ARMCO Atreaeurch On Gn Med Lo 21-6-9	On Gn Med	Med		67		Yellow Corroston Products (7)	Yellow Corrosion Products (7)	0.1	4.0	g &	:	0,0054	39.0	10.0	1.0	~
20-Cb-3 Airesearch Gn Gn Med Lo	On Gn Med	Med		5		Green Corrogion Products; metal etched (7)	White Corrosion Products	2.0	0.5	g (6)	!	0.0007	25.0	63.0	0.1	=
Chromized Airesearch (in Gn Med Lo linynes-25	CD CD Med	Po W		3		Red, Black, and Green Corrosion Products; coating removed (9)	White Corrosion Products: confing removed (9)	1.7	2.4	Dark Kreen Hquid (2)	0.2713	!	71.0	48.0	0.1	Ħ
Chromized Airesenrch Gn Gn Med Lo C 440C	Gn Gn Med Lo	Med	3		- L	Green Corrosion Products; coating removed (9)	Conting removed: metal severely etched (10)	3.6	1112.0	Dark green liquid (2)	18.49	1	291.0	288.0 (11)	1.0	2
2021/2021 LMSC Gn Gn Mod 1.0 Wi Weld Ca	Gn Gn Med 1.0	Mod 1.0	0,1		≥ 2 2	White Corrosion Products; cavities on weld (7)	While Corrosion Products; attack on weld and HAZ (7)	0.3	<b>4</b> 3	> p (5)	0.0432	\$ 2 2	48.0	14.0	1.0	=
2219/2219 LMSC Gn Gn Med Lo No weld	Gn Gn Med Lo	Med Lo	Ç		ž	No Effect (1)	White Corrogion Products; attack on weld and HAZ (7)	4.0	*:	5 (§	0.0303	ļ	38.0	2.0 (1)	1.0	=
M-50 Alloy Atrenanceh Gn Gn Med Lo Wh	Gn Gn Med Lo	Med Lo	To		P K	White Corrosion Products (?)	White Corrosion Products (7)	8.0	E: 1	o ∨ 8	ļ	0.0065	118.0	206.0	1.0	=
316 Airesearch Gn Gn Med Lo Whii	Gn Gn Med Lo	Med Lo	<u>9</u>		Whii	White Corrosion Products (7)	Etched (5)	5.2	9.0	Clear (B)	;	0.0047	(2)	9:E	1.0	-
H 1025 Ch Gh Med Lo Whi H 1025 mod etch	On Gn Med Lo	Med Co	3		Pro Pro etch	White Corrosion Products: metal motified and etched (7)	Vellow Corrosion Products; etched (?)	ri O	6:0	Clear (1)	!	0.0070	(2)	(7)	\$	-
Med · 0.4 to 0.8 Weight-Percent Lo · · <0.5 Weight-Percent Numbers in parentheses refer to applicable computer code. Refer to Table VII for definition.	0.4 to 0.8 Weight-Percent <0.5 Weight-Percent rentheses refer to applicable computer code. H	-Percent Sont applicable computer code. R	t de computer code. Re	uter code. He		sfer to Table VII	for definition.	والمها والمها والما	generation of the state of the							

TABLE XVI (4 of 5)

_								
	Rating (Refer	To Table II)		<b>=</b>	Ē	=	=	=
	s/s	(fn. <sup>-1</sup> )	1.0	1.0	0.1	1.0	1.0	e 1
	Deposits (mg)	Liquid	61.0 (1)	54.0	309.0	(3)	(3)	(2)
	) Iaci	Vapor	4.0	!	i	0,6)	(2)	49.0
	t-r	1.c2O3	0.0044	1	!	1	0.0020	0.0014
Acid	∆ Wt 'T	$M_2O_3$		0.5713	0.4636	0.3776	!	!
	Phys.		Clear	Dark red liquid > p (5)	Green Hguld > p (5)	Dark red Hquid > P (5)	۲. ق	g (5)
	Corrosion Rate (Mils/Year)	Liquid	<0.1	24. 25.	7.4	». ••	8.0	0.9
	Corr Re (Mils	Vapor	0.3	:	!	4.0	0.2	0.1
		⅌		rrosion : plate ru	rrosion . plate ru		White Corrosion Products in crevice (7)	White Carrogion Products in crevice (7)
Metals	pearance	1.fqufd	Etched (5)	Green Corrosion Products: plate broken thru (9)	White Corrosion Products, plate broken thru (9)	Etched (5)	White Corrosion Products in crev (7)	White Carrosion Products in crevi (7)
	Physical Appearance	Vapor 🖄	White Corrosion Products (7)	i	!	Brown Corrosion Products (?)	White Corvosion Products in crevice (7)	White Corrosion Products in crevice (1)
	o.,	- (a)	3	<u>o.</u>	0,	1.0	9	9
	7	⋖	Med	Med	Ned Med	Med	Med	Med
	NTO		Gn Gn	en Gu	53 G	5	G G	то чо
	Source		Airesearch	Airescarch	Airesenrch	Afresearch	Airesearch	Alregearch
	Material		17-7 PH Spring Wire	Rh plated Haynes-25	Rh plated 440C	MP-35-N	304L/304L TIG Weld	347/347 Tig weld
	Test	į	240	250	150	252	253	254

o.4 to 0.8 Welght-Percent Med

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1.0 " <0.5 Weight-Percent Numbers in parentheses refer to applicable computer code. Refer to Table VII for definition.

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TABLE XVI (5 of 5)

						Compatibility Test Results	٠	Nonmetals						
						Dhoeloo		plastic F	Plastic Physical Properties	ertics		Ac	Acid	Rating
Test No.	Mate: lal	Source	NTO	# <b>(</b>	°≪	Appearance	Weight ( $\Delta$ %)	Volume	Hardness  Δ Shore D Units	Width ( A In.)	Thickness ( A In.)	Phys. Appear.	Particulate (mg/liter)	(Refer To Table II)
503	Rulon A	Airesearch	Gn Gn	Med	ដ	Color change, red to white (4)	+ 4.2(V) + 5.6(L)	+10.2(V) +10.2(L,	+ 4(V) + 3(L)	+0.0106(V) +0.0087(L)		Clear (1)	1.0	11
220	25% Glass Filled Teflon	LMSC	Gn Gn	Med	ន	Color change, yellow to white (4)	+5.2(V) +7.2(L)	+ 8.5/V) +12.8(L)	- 2(V)	! !	+0.003 (V) +0.003(L)	Clear (1)	3.3	=
233	Kel-F 5500	Bell Aerospace	Gn Gn	Med	្ន	Spongy and swollen (4)	-28.3(V) -12.2(L)	+12.2(V) + 7.6(L)	-30(V) & -30(L)	11	+0.083 (V) +0.086 (L)	Clear (1)	1.0	Ħ
234	Kel-F 81	Airestarch	Gn Cn	Med	្ន	Color change, transparent to yellow (4)	+ 0.4(V) + 0.5(L)	+ 0.3(V) + 0.5(L)	0 (E)	+0.0007(V) +0.0005(L)	-0.002 (V) -0.001 (L)	Clear (I)	1.0	=
235	Ruion LD	Airesearch	Gn Gn	Med	21	Color change, red to gray; white salts from filler, retains acid (4)	+ 4.6(V) + 5.2(L)	+14.1(V) +29.9(L)	- 3(V) - 3(L)	+0.013 (V) +0.005 (L)	+0.006 (V)	Clear (1)	0.1	=
236	Fulon 123	Airesearch	E	Med	ទ	No effect; retains acid (1)	+ 8.2(V) + 8.7(L)	+ 7.3(V) +10.6(L)	- 3(L)	+0.016 (V)	(V) 900.0+	Clear (1)	0.3	<u></u>
ବ୍ରବ୍ର	Med = 0.4 to ( Lo = <0.5 W tumbers in parenth	0.4 to 0.8 Weight-Percent <0.5 Weight Percent parentheses refer to applic	nt Icable con	nputer co	de. Refe	Med = 0.4 to 0.8 Weight-Percent Lo = <0.5 Weight Percent imbers in parentheses refer to applicable computer code. Refer to Table VII for definition.	ítion.		& 5 € & 1 .	Shore A - Mr - Vapor - Liquid	Material too soft for Shore D	it for Shore D	•	

TABLE XVII

NON-ROUTINE ANALYSES (1 of 2)

			Film As	alyses	Non-Volatile Residue By		Metallo-
Test No.	Material	Particulate (mg/liter	Ву ЕМР	Spectroscopic	Emission Spectrograph	Other	graphic Analyses
30 Da	y Tests, 120°F						
191	NITUFF on 6061 A1	0.5					
195	Rulon LD	0.8					
196	Rulon 123	0.3					
197	Kel-F-81	0.1					
6 Hou	r Tests, 220°F						
224	AM350						General, even surface attack (Reference 2)
60 Da	y Tests, 90°F						
205	Columbium C-193 (W R512E Coat)				Cb, Fe, Cr, Ni, Ti, Zr		Most of coating removed, diffusion layer intact, edges pitted (Reference 3)
206	17-7PH FACOND A				Fe, Cr, Ni	<b>-</b>	
207	Au/Ni Braze Alloy					59.0 WT % Ni IN NVR	
208	17-7PH RH 1050				Fe, Cr, Ni		Pitting at gcain boundaries (Reference 3)
210	AM350-Screen					Specimen Identification	
211	304 (L)					Specimen Identification	
212	321/321 Welded Bellows (Liquid Phase Sample)			~~~			HAZ (Heat Affected Zone) and Tack Welds Attacked (Reference 3)
214	321/321-308 Filler-Weld (Liquid Phase Sample)						Smeared metal on cut ends attacked (Reference 3)
215	304/304-308 Filler-Weld (Liquid Phase Sample)					Specimen Identification	Attack at end grain inclusions (Reference 3)
220	25% Glass-Filled Tellon	3.3				Si In Particulate	×=-
237	i7-7 PH Torque		Fe, Cr, Ni, Mn, Al: F, S, Cl				
238	304L		Fe, Cr, Ni, Mn: F				
240	ARMCO 21-6-9		Fe, Cr, Ni, Mn: F				

Refer to Section VI for References

TABLE XVII (2 of 2)

			Film A	nalyses	Non-Volatile Residue By		Metallo-
Test No.	Material	Particulate (mg/liter)	Ву ЕМР	Spectroscopic	Emission Spectrograph	Other	graphic Analyses
60 Day	y Tests, 90°F, (cont)						
242	Chronitzed Haynes-25		Co,Fe,Cr,Ni: F	Co,Fe,Cr,Ni,W	Co,Fe,Cr,Ni,W		
244	2021/2021-Weld (Liquid and vapor phase samples)						For liquid phase sample: Grain boundarier of weld and HAZ attacked; For vapor phase sample: Welding pores (Reference 3)
245	2219/2219-Weld (Liquid phase sample)		Al,Cu,Mn: F				Grain boundaries of weld and HAZ attacked (Heference 3)
246	M-50 Alloy		Fe,Cr : F?			F in film	
250	Rh plated Haynes-25		Rh,Cr,Cu, Mn Ni,Si	Ni,Co	Rh,Cr,Ni,Co W,Fe	No F <sup>*</sup> in film	Most of plate re- moved, little attack on substrate (Reference 3)
251	Rh plated 440C				Rh (?),Cr,Cu, Fe,Al		All of plate removed, light attack on substrate (Reference 3)
252	MP-35-N				Ni,Co,Cr,Mo		
252	MP-35-N 347/347-TIG Weld		Fe,Cr :F	Fe,Cr,Ni	Ni,Co,Cr,Mo Fe,Cr,Ni		

Refer to Section VI for References

TABLE XVIII

## HDA COMPATABILITY TESTS

Rating	(Refer to Table II)		6 <sub>0</sub> 6 <sub>0</sub> 6 <sub>0</sub> 6 <sub>1</sub> 6 <sub>1</sub> 6	day 100 day 100 day 100			
Raf	(Ref to	=2	28288	22222	<u>=</u>	=	
	Hardness (Shore D) Units	11	21 22 11 11 11 18	24 25 25 25 25 25 25 25	ç	<b>φ</b>	ę
erial	Vol. 🤻		0.10 0.25 0.44 0.44	777777 0000 0000	7.3	0.0	رة د
Changes in Material	·k. 3/31	11	1.1 0.3 1.4 0.5 0.5		3.2	2.6	7
Ֆևոու	Physical Appearance	Losing Carbon Tacky, inclustic, Deformed	Ton Light Ton Ton Light Ton Ton	Tan Light Tan Tan Light Tan , Tan Light Tan	Color Change Red to Grey	Surface Change Smooth to Rough	Color Change White to Amber
70	Others	nlack Particles	IR Neg. for Halocarbon IR Neg. for Halocarbon III Neg. for 'alocarbon	IR Neg. for Halocarbon IR Neg. for Halocarbon IR Neg. for	O.8 mg Particulate/liter	0.3 mg Particulate/liter	0.1 mg Particulate/liter
Changes in Acid	Composition	::	-1% NO <sub>2</sub> -2% NO <sub>2</sub> -3% NO <sub>2</sub>	-1% NO <sub>2</sub> -2% NO <sub>2</sub> -3% NO <sub>2</sub>	i	;	!
	Physical Appearance	None Discolored	None None None	None None	o,	OK	O.X
	Tump (°F)	2.2	2	70	120	120	13.0
	Tlan	1 Hour 16 Hours	3 Pays After Outgas T Pays After Outgas 3 Days After Outgas	3 bays After Outgas 7 bays After Outgas 3 bays After Outgas	7 Days	7 Days	7 Days
	Material	r P Rubber	Tofka - TPE	Kel- F 5560	futon I.D	Rulon 123	Kel-F 31

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TABLE XIX

COMPATABILITY OF VARIOUS METALS WITH STANDARD HDA (1 of 3)

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	Time	Temp	s/v	Physical A Of Me			ion Rate 'Year)	Physical Appearance	∆ Wt	Ą	Rating (Refer
Material	(Days)	(°F)	(In. <sup>-1</sup> )	Vapor	Liquid	Vapor	Liquid	Acid	M <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	To Table II)
SAE-52100 Not Hardened	4	120	0.2		Discolored		1.7	Clear	0.904	0.003	11
449C Not Hardened	7	120	0.5		Corrosion Products		4.8	Clear	0.005	0.004	II
440C Rockwell C58	7	120	1.0	Pits; Corrosion Products	Pits; Corrosion Products	1.6	4.3	Clear		0.002	Ħ
440C Cr Plated	7	120	1.0		Plating Flaking			Clear		0.005	īv
AM 570 Bellows	7	120	1.4		Corrosion Products		1.8	Clear		0.003	11
W247/ AM 350	7	120	1.0		White Corrosion Products Welds Etched		3.1	<b>&gt;</b> p		0.005	Ш
E-Brite 26-1	7	120	1.3	Pits; Discolored	No Effect	4.2	3.1	Clear	0.018		III
ARMCO 21-6-2	7	120	1.0	Light Green Corrosion Products	Light Green Corresion Products	0.5	2.2	>p		0.007	III
W302/301	7	120	1.0		302 Etched		4.4 (total)	Clear		0.006	11
304].	7	120	1.0	No Effect	No Effect	 0.6	1.1	Clear P		0.005 < 0.001	11 11
316 ELC	7	120	1.0	Gray Stains	Light Green Corrosion Products	0.6	2.5	Clear		0.005	11
347 Sheet	7	120	1.0	Discolored	Pits Discolored	0.5	3.4	р		0.006	ш
347 Full Hard	7	120	1.0	No Effect	No Effect	0.5	2.3	>ט		U.007	111
W347 Sheet	7	120	1.0	Discolored	Discolored	0.8	3.4	>p		0.005	111
W347 Bellows	6	120	1.3		Pits Discolore		2.4	p		0.009	Ш
Worthite	7	120	0.5		Etched		2.0	Clear	0.013	0.001	11
C347/ Cr Plated Worthite	7	120	1.0 (total)		Etched No Effect		2.4 < 0.1	Ciear		0.004	II I
Carpenter-20	7	120	0.1		Discolored		3.4	Clear	0.005	0.602	11
Nickel	6	120	0.7		No Effect		190	Discolored	0.299		17.
Haynes Star J	7	120	1.0		Severe Etch		32.6	Discolored	0.40;		111
Haynes - 25 Bar Stock	7	120	0.€		Etched		3.3	Discolored	0.089		п
Haynes - 25 Screen	7	120	1.0		No Effect		3.8	Clear		< 0.001	11

TABLE XIX (2 of 3)

	Time	Temp.	s/v	Physical . Of M	Appearance etal	1	sion Rate s/Years)	Physical Appearance	ΔW	( <del>)</del>	Rating (Refer
Material	(Days)	(°F)	(In. <sup>-1</sup> )	Vapor	Liquid	Vapor	Liquid	Acid	M <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	To Table II)
C Haynes-25/ 304L	7	120	1.0 (total)	 	No Effect No Effect	 	1.0 2.1	Clear		0.004	11 11
MP 35N	4	120	0.4		No Effect		5.4	Clear	0.180		121
Multimet	7	120	1.0		Corrosion Products		5.2	>p	0.005		111
17-7 PH Torque Fube	7	120	1.0		White Corrosion Products in capillary		4.4	Clear		0.006	ti .
17-7 PH RH 950	7	120	1.0	White Corrosion Products Etcl:ed	White Corrosion Products Etched	.7	2.5	Clear		0.007	11
17-7 PH RH 1050	7	120	1.0	White Corrosion Products Etched	White Corrosion Products Etched	0.7	3.0	Clear		0.006	11
Al on High~ 'rength Steel	7	120	0.5		No Effect		0.5	Clear	9.003	0.003	i
356-Hard Coated	6	120		•••	No Effect		1.8	Clear	0.002		11
C356-T6/ 304	7	120	1.0 (total)	White Corrosion Products in Crevice	White Corrosion Products in Crevice	1.9 5.1	3.4	Clear	0.007	0.003	11
C356-T6/ 304L	7	120	1.0 (total)	Whitc Corrosion Products in Crevice	White Corrosion Products in Crevice	3.4 2.4	2.4 0.6	>p	9.006	0.005	11 11
2021	7	120	1.0		No Effect		< 0.1	Clear	0.007		1
W2021	7	120	1.0		No Effect		0.1	Clear	0.003		1
2219	7	120	1.0		No Effect		< 0.1	Clear	0.007		1
W2219	7	120	1.0		No Effect		< 0.1	Clear	0.005		i
5033	7	120	1.0		No Effect		< 0.1	Clear	0.001		1
W5083	7	120	1.0		No Effect		< 0.1	Clear	0.001		I
5086	7	120	1.0	No Effect	No Effect	1.0	0.1	ок	< 0.001		ı
W5086	7	120	1.0	No Effect	No Effect	< 0.1	0.2	ок	< c 001		ı
5454-1132	7	126	1.0	No Effect	No Effect	< 0.1	9.1	Clear	< 0.001		1
W5454-H32	7	120	1.0	No Effect	No Effect	< 0.1	< 0.1	Clear	< 0.001		1
5454-0	7	120	1.0	No Effect	No Effect	- 0.1	ი.ვ	ОК	< 0.001		I
6061-T6	7	120	1.0	Discolored	No Effect	< 0.1	< 0.1	Ciear	0,002		ŧ

TABLE XIX (3 of 3)

Material	Time	Temp.	s/v	Physical A Of Me			sion Rate (Years)	Physical Appearance	Δ Wt	ą.	Rating (Refer
meerial	(Days)	(°F)	(In. <sup>-1</sup> )	Vapor	Liquid	Vapor	Liquid	Acid	M <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> O <sub>3</sub>	To Table II)
W6061	7	120	1.0	Discolored	No Effect	< 0.1	0.2	Clear	0.003		I
Nituff on 6061	7	120	1.0	~~~	Irridescent			ок			11
C6061-T6 (H <sub>2</sub> SO <sub>4</sub> ) Anodize	7	120	1.0 (total)	Anodize OK except for White Corrosion Products in Crevice	Anodize OK except for White Corrosion Products in Crevice	0.1	3.6	Clear	0.015	0.007	11
304L				No Effect	No Effect	0.6	0.5				1
Beryllium	7	120	0.4		Corrosion Products		1.9	ок	0.003		II
Hafnium Diboride	7	120	1.0		Corrosion Products		59.5	P	0.509		ľV
Platinum Cobalt Alloy	7	120	0.1		Discolored Blue-Black		0.8	Clear	0.002		1
Tantalum	7	120	1.0		Dissolved			Clear	0.458		īv
Tungsten	2	120	1.1		E'ched		647	>p	2.017		īv
Tungsten Carbide	7	120	1.0		Corrosion Products		1110	Р	1.005		IV
Cb-1-Zr	6	120	0.8		Pits Corrosion Products		98.1	>p	<b>6.566</b>		IV
SCb-291	7	120	0,6		Pits Corresion Products		132	Cloudy	1.502	<b>-</b>	rv
Cb 103/A505	7	120	0.7		Pits Corrosion Products	~	72	Clear	0.453		īv
SCb 291/R508C	2	120	1.6		Corresion Products		773	>p	1.574		IV

TABLE XX
SATISFACTORY MATERIALS FOR GENERAL USE WITH STANDARD HDA

Se	rvice A	t		Se	rvice At	
90°F	120°F	220°F	Materials	90°F	120°F	220°F
			300 Series Stainless Steel			
х			304L	X		(II)
x			316 Spring Wire	x		
,	х		347	x	(III)	
	х		Other Metals			
	х		17-4 PH H1025	x		
x	x x x		17-7 PH Fully Annealed Cond. A  17-7 PH Spring Wire  17-7 PH Torque Tube  PT-CO Alloy  Nonmetals  Rulon 123	x x x	(II) X (II)	
	90°F X X	90°F 120°F  X X X X X X X X	x x x x x x x x	90°F   120°F   220°F   Materials	90°F 120°F 220°F Materials 90°F	90°F 120°F 220°F Materials 90°F 120°F  X

TABLE XXI

MATERIALS SATISFACTORY FOR REPEATED SHORT TERM USE WITH STANDARD HDA

	Service At				Service At		
Materials	90°F	120°F	220°F	Materials	90°F	120°F	220°F
Aluminum Alloys				Other Metals		-	
356-T6			x	M-50 Alloy	x	,	
2021/2021 Welded	x			440C	х	(111)	
2219/2219 Welded	x			AM350 Screen	x		
Nituff On 6061 Al		х		17-7. PH RH 950		x	
300 Series Stainless Steels				17-7 PH F.ii 1050	x	x	
302/304L Weld		х		ARMCO 21-6-9	х	(III)	
304/304-308 Filler Weld	x			20-Cb-3	x	x	
304L/304L TIG Weld	x			Haynes-25 Screen		x	
304L	(I)		x	MP-35~N	х	(III)	
304L Work Hardened	x			Nonmetals			
316		x		Kel-F 81	x	x	
321	х			Rulon A	x		
321/321 Bellows Res. Weld	x			25% Glass-Filled Teflon	x		
321/321-347 Filled Weld	x						
347/347 TIG Weld	x	(III)					
			1			<u> </u>	<u> </u>